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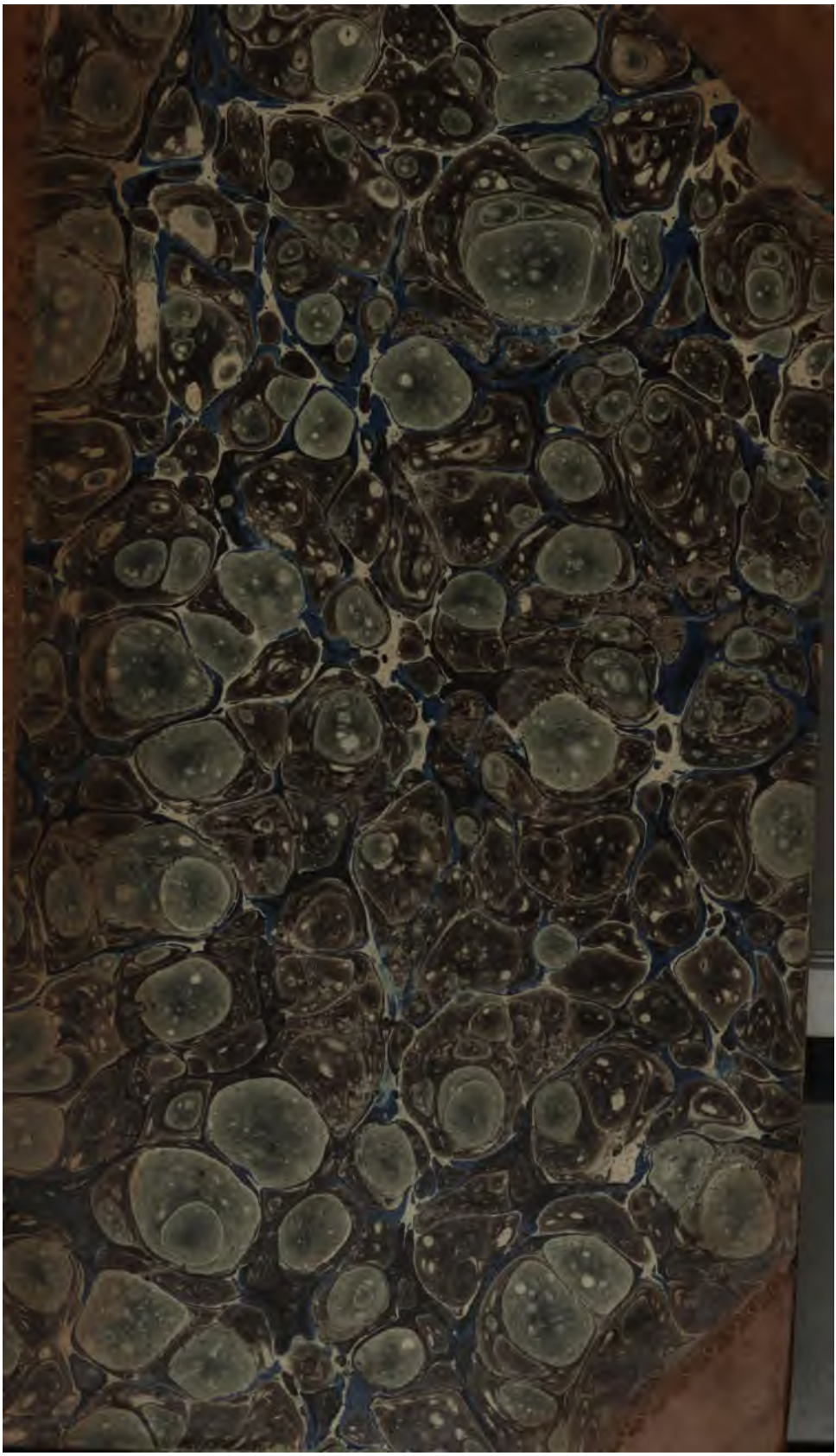

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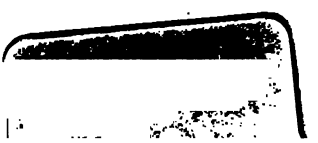

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THE

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CONTAINING

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ON SUBJECTS CONNECTED WITH

DISCOVERIES AND IMPROVEMENTS

IN THE

USEFUL ARTS.

ILLUSTRATED BY NUMEROUS ENGRAVINGS.

BY THOMAS GILL,

A CHAIRMAN OF THE COMMITTEE OF MECHANICS IN THE SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES, AND COMMERCE, ADELPHI.

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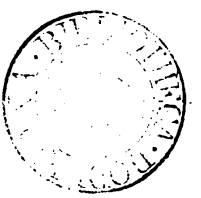

VOL. I.

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1822.

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ADVERTISEMENT.

THE Editor and Proprietors of the Technical Repository avail themselves of the opportunity afforded by the completion of the First Volume, to return their thanks to the Public for the encouragement which they have been pleased to bestow on this undertaking.

It is no small gratification to find, that, amidst the various, and perhaps in some instances ostentatious, claims to notice set forth by periodical works, more or less similar in plan to that of the Technical Repository, the result of six months' experience has proved that unassuming utility still continues to be duly appreciated by the British Public. In return, the Proprietors trust that that Public will perceive the increasing and anxious endeavour, on the part of the Editor, to contribute, from his own stores, numerous Articles of immediate practical value. The communications with which he has been favoured, both from his personal friends and from strangers, have, in number as well as importance, exceeded his anticipations; and will doubtless continue to increase with the increasing stability of the work. But it is by no means wholly on domestic resources that he depends for a supply of interesting matter. The felicitous experiments of the French Chemists have lately furnished valuable information, which promises the greatest advantage to our manufacturers; especially with the partial removal of the Salt Tax, which, in 1806, *by a mistaken policy, destroyed the further progress of many manufactures throughout this kingdom, causing numerous valuable residuums to be thrown away, which in the French laboratories have been converted to an extensive use, and which may now be expected to render us many advantages, both national and individual.*

The introduction of Articles relative to the practice of Medicine and Surgery having been disapproved by some of our Readers, as foreign to our object, we would observe, that we consider the Healing Art as appertaining to Technical Science in numerous instances; not only as respects the better preparation of mineral and vegetable compounds, the apparatus for surgical operations, &c., but as it is the peculiar duty of Medical Men to investigate and point out to the Public those diseases and accidents which affect the health and life of the artisan, and arise from the nature of his occupation. The Public in general are not at all aware of the number of individuals annually sacrificed in unhealthy and hazardous employments; and any

authentic communications on this subject, from Professional Men, will be peculiarly acceptable, both as shewing the real cost of many articles of necessity as well as of luxury, and because, when the mischief is generally known, the discovery of means of relief or of prevention becomes more likely.

This leads us to observe, that next to the Members of our Philosophical Societies, whose minds are constantly exercised in the various paths of Technical Science, we consider our work peculiarly appropriated to Reading Rooms, or Reading Societies, which are now forming in almost every town or respectable village; wherein the Merchant, the Medical Professor or Chemist, the Farmer or Horticulturist, the Mechanician, Artist, or Handicraftsman, may find instruction in the study of Technical subjects, suited not only to the business which each practises, but such as may, by analogous processes, beget new ideas, and induce them to examine how far any new inventions may be applied to that branch which each exercises;—for all Arts reciprocally tend to one common perfection.

A work of such a varied tendency cannot fail to elicit new ideas, and give elasticity and energy to our national industry. A train of thinking, like mathematical studies, gives to the mind an increased momentum, and raises the otherwise inactive Mechanic to a course of experiments, which frequently lead to his aggrandizement, and certainly to his country's advantage. We live indeed in an age when, with some few exceptions, Potentates and Princes bestow personal attention on the Mechanical Arts; and a patent of Nobility is not thought to be dishonoured by its possessor joining with Artisans in executing some plan of mechanical improvement;—as wisely observing, that Technical Science advances Agriculture and Commerce and other useful Arts, as well as those of taste and elegance; and that hereon depend, next to Religious and Moral regulations, a nation's strength, prosperity, and riches.

PROSPECTUS OF THE WORK.

THE Proprietors of this Work, in presenting it to the notice of the Public, conceive it their duty to apologize for adding another Periodical Work to those already published.

They have long had it in contemplation, to provide a vehicle, which should convey to the Public *sound Practical Information* on the Useful Arts, free from those visionary projects which only tend to bring real science into discredit; such, for instance, as the notable one of the Chevalier Cadit de Gassicourt, lately announced in several of our Periodical Journals, for propelling vessels through the water by the agency of Bramah's Hydraulic Press; a machine certainly of incalculable benefit in many of its applications, but totally unfit for the object which the Chevalier had it in view to accomplish. In order to avoid such mistakes, an Editor of competent talent became of the first consideration; one, on whom the onus of responsibility might lie; and who, independent of his own numerous resources, would be able to decide on, and select, the fittest Articles for the public eye, out of the materials with which his Correspondents should from time to time furnish him.

The Proprietors have continually witnessed the ardent zeal with which Mr. GILL, for a long series of years, has fulfilled the duties attached to the important office of Chairman of the Committee of Mechanics, in that patriotic Institution, "The Society for the Encouragement of Arts, Manufactures, and Commerce,"—incited solely by his desire to benefit society, through the powerful instrumentality of the resources and influence possessed by that Respectable Body: and had often thought, that, could he be induced to devote his attention to the conducting of a

Practical Work of this description, no one would be more fitted to undertake the important task. They were, therefore, prepared and happy to close with his proposition to edit the TECHNICAL REPOSITORY, and undertook to forward his intentions to the utmost of their power.

It may be proper to add, that Mr. GILL has always enjoyed the most favourable opportunities of acquiring practical knowledge; and is already provided with an abundance of original and valuable materials in many volumes of his Common-place Books. He is likewise favoured with an extensive Correspondence with Foreigners of eminence in the several walks of Science; which it will be his constant study to enlarge, by affording every facility to the publication of their new and useful discoveries.

Each Number of the Work will contain five sheets, octavo, with such Plates as may be necessary for the illustration of the different subjects; price Two Shillings and Sixpence.—Six Numbers to form a half-yearly volume, with a complete Index; price Fifteen Shillings, half-bound.

THE

TECHNICAL REPOSITORY.

I.—*Specification of the Patent granted to* JAMES SMETHURST, *of St. Margaret's Hill, Southwark, in the County of Surrey, Lamp Manufacturer and Contractor; and* NICHOLAS PAUL*, *of Villiers Street, Strand, in the County of Middlesex, Mechanician; for certain Improvements applicable to Lamps and Reflectors.—Dated 30th Oct.* 1802. *Term expired.*

WITH SIX PLATES.

WE, James Smethurst and Nicholas Paul, do hereby declare, that our said invention, and the said improvements applicable to Lamps and Reflectors, consist in several particulars with respect to each, the most important of which may be classed under two general heads; to wit:

* The Editor is happy in the opportunity now afforded him of doing some justice to the memory of this most ingenious and worthy individual. He was a native of Geneva, and director of the Hydraulic Works in that city; and also the establisher of artificial mineral-water manufactories and baths there, as well as at Paris and Lyons; and likewise of an artificial mineral-water manufactory in London.

This patent affords one of the rare instances of a sound theory being most skilfully reduced to practice; notwithstanding which, owing to the sudden death of Mr. Paul by apoplexy, and other untoward circumstances, his inventions have hitherto been carried very little into effect; and, possibly on account of the great length of the specification and the numerous explanatory drawings annexed to it, the patent has never been published.

The Editor having been appointed by Mr. Paul his *Patent Agent*, was made fully acquainted by him with every particular relating to the proper construction of his lamps and reflectors: and, although he is

"Improvements applicable to the Lamps themselves," and "Improvements applicable to Reflectors."

The improvements applicable to the Lamps themselves are: First, that by means of a drawing or register tube, with a proper register adapted to it, in the lower part of the case or receptacle in which the lamps are contained; by air-tubes in or out of the body of the lamp itself; by a proper sloping form given to the glass chimney or dome of the lamp surrounding the burner (all of which will be hereafter more particularly described); or such of the said contrivances as are applicable in any particular case; we procure that degree of access of air to the burning portion of the wick, which is capable of producing the most accurate and luminous combustion of the oil, grease, tallow, wax, or other oleaginous, sebaceous, or combustible substance with which the lamp is supplied; and, also, that a proper degree of heat may be constantly maintained around the flame, and the flame at the same time rendered as long as is consistent with such accurate and luminous combustion; so that the greatest possible efflux of light, which a wick of any given form and dimensions, supplied with any given oleaginous, sebaceous, or combustible substance, is capable of affording, may be constantly produced. Secondly, that, by means of a simple contrivance (also to be hereinafter more particularly described), the burner containing the wick may be easily removed from the lamp, either for the purpose of cleaning it, or for substituting, in its stead, another of different form or dimensions. And,

determined to afford every facility to the display of Mr. Paul's inventions, by causing Plates to be executed on a scale sufficiently large to exhibit clearly every part; yet there will inevitably remain much detail to be communicated to manufacturers personally.

The Editor has also, through the kindness of a mechanical friend, Mr. Bruguier, of Greek Street, Soho—a native of Geneva, and a manufacturer of those ingenious pieces of mechanism, the musical boxes, seals, &c.—been favoured by him with a drawing and description of the lamps and reflectors employed in lighting the streets of that city, so late as the year 1816; affording much information on the application of Mr. Paul's principles, at a period considerably later than the date of the patent;—which description will follow this specification of the patent.

Thirdly, that, by means of certain other simple contrivances (also to be hereinafter more particularly described), a more copious and unimpeded flux of the oil, grease, tallow, wax, or other oleaginous, sebaceous, or combustible substance, with which the lamp is supplied, may be afforded to the wick.

The improvements applicable to the reflectors, are: First, that they shall be so formed, as to reflect those rays issuing from the flame of the lamp, which, without their interposition, would fall in a direction in which they would be useless, according to the purpose for which the lamp is applied; in such a manner, as to diffuse and distribute them over the whole surface or extent of space to be illuminated; so that the whole of the light, falling on every portion of such surface or extent of space, both from the direct rays of the lamp, and after reflection from the reflector, may be as nearly equal and uniform as is practicable. And, Secondly, that the reflector shall be so constructed, as to reflect such rays as fall on those parts of it which are nearest to the flame of the lamp, to the most distant parts of the surface or extent of space to be illuminated; and such of the rays as fall on those parts of the reflectors which are most distant from the flame of the lamp, to the nearest parts of such surface or extent of space to be illuminated; so that, with respect to every part of the reflectors, the reflected rays may be the longer, in proportion as the incident rays are the shorter, and the converse.

Having thus stated, in general terms, the principal objects of our improvements, we shall proceed to explain them more in detail, with reference to the annexed Drawings.

In the annexed drawing, No. I, plate I; fig. 1, represents the common street-lamp, with its reflectors, according to our present mode of constructing it, in its glass vase, J, with its rim, K, and cover, N. And fig. 2, the same lamp, with its reflectors varied at right angles to their position in fig. 1, and taken without the glass vase, J, or its cover, N: the several other figures, from 3 to 15, in the same drawing, representing the various

parts, as taken separately. The same letters of reference denote the same parts, both in those figures in which they are taken separately, and in the figures 1 and 2, in which they are represented together. A, fig. 1, 2, and 3, is the body of the lamp, through the bottom of which pass the two air-tubes, *a*, *a*, open at the top and bottom, and passing, in the present instance, through the oil with which the lamp is filled. This, however, is not absolutely necessary, as they may, by changing the form of the body, also be made to pass on its outside. The slope, *b d*, represents the form of the superior part of the lamp, and which is materially conducive to the brilliancy of its flame, by preventing that impediment to the current of air on the outside, which would be produced by a larger surface at *b*, *b*, with a square shoulder. It contains the wick-holder, B, fig. 4 and 5, which is a flat tube or pipe, having the metal, of which it is formed, prolonged below on one side, in a curved direction, nearly to the bottom of the body of the lamp, in order to support the wick, and to assist the oil, or other combustible material employed, in its ascent: this tube is fixed into a convex circular plate, (which rests upon three or more projecting parts made on the inside of the conical part of the body of the lamp at *b*, *b*, for the purpose of supporting it,) and whose use is, to cover and defend the oil, or other combustible material employed, from dirt, and from the action of the flame of the lamp; and it has two slits or holes made in it, as represented in fig. 6 and 9, to permit the air-pipes, *a*, *a*, in the body of the lamp, to pass through. When grease, tallow, wax, spermaceti, or any other fit combustible material, is to be consumed, which requires to be kept in a state of fusion; an additional tube is fixed underneath it, to permit a piece of metal wire, P, fig. 2, to be put through it, which reaches to the bottom of the body of the lamp, and whose upper extremity rises above, and is placed so near the end of the flame of the lamp, as to be heated by it sufficiently to warm the bottom of the body of the lamp, and, by this means, to keep the combustible material em-

ployed, in a fluid state, and fit for combustion. When oil is employed, it is kept in a due temperature by the vicinity of the flame alone, without the necessity of employing the said wire, P, to heat it. The body of the lamp, A, is contained in the exterior case or receptacle, C, fig. 2 and 7, from the bottom of which a tube proceeds; the intention of which is, to cause a proper draft of air to flow to the bottom of the lamp. To the bottom of this tube, a moveable cap, *c*, is fitted, having its sides perforated with a number of holes or slits; so that, by sliding the cap upwards or downwards, it performs the office of a register or regulator: and the quantity of fresh air necessary to be admitted through the said drawing or register tube, *c*, and the air-pipes, *a*, *a*, so as to support the combustion of the combustible material employed, is admitted and regulated; and, passing through the said air-pipes, *a*, *a*, in the body of the lamp, A, is directed upon each side of the flame in currents, so as to act upon it with that degree of force, which is found, by experiment, to be most conducive to the brilliancy of the flame. The upper part of the said tube proceeds a little above the bottom of the exterior case or receptacle, C, in order to catch and detain any small portion of oil, or other combustible material employed, which might happen to drop upon the said bottom, and thereby prevent its falling into the said tube. Upon the flat upper part of the body of the lamp, A, are fixed three or more thin or narrow plates of metal, which are shewn at *d*, *d*, *d*; the use of which is to support the glass dome or chimney, D, fig. 8, so as to permit a third current of air to pass underneath it, and by the sloping or conical sides, *bd*, *bd*, fig. 3, of the superior part of the body of the lamp; which third current causes the wick of the lamp to burn much longer, without requiring to be snuffed; and tends to keep up a proper degree of temperature, in the atmosphere immediately surrounding the flame; and to maintain a due supply of air, in a fit state for supporting combustion, to every part of the flame. E, fig. 1, 2, and 10, is a metal ring, having two recesses made in it, to permit two projecting parts, *e*, *e*, fixed

to the receptacle of the lamp, C, fig. 1, 2, and 7, to pass through them; which projecting parts, when entered, being turned round towards the right hand, until they are in contact with the stops, *f*, *f*, made on the upper part of the ring, E, the said receptacle, C, containing the body of the lamp, A, will be in its proper position in the said ring. The body of the lamp, A, has a projecting piece, *s*, fig. 1, 2, and 3, which fits into a recess made for it in the side of the receptacle, C; by means of which the body of the lamp is kept in a proper position in the receptacle, C; and thus the flame becomes properly posited in respect to the reflectors, hereafter to be described. The stops, *f*, *f*, fig. 10, also prevent the receptacle, C, from being turned the wrong way, on entering it into the ring, E; and determine the proper situation of the two supports, *e*, *e*, when the receptacle is to be taken out of the said ring. Two arms, *g*, *g*, fig. 1, one of which is also exhibited in fig. 2, project on each side from the recesses in this ring, E, having slits, to receive the ends of the descending branches or legs, *h*, *h*, of the metal chimney, F; and which said ends are riveted or otherwise fixed to the ring, E, at *g*, *g*, and thus connect the lamp, A, in its receptacle, C, with the said metal chimney, F. In this chimney are made two slits, *i*, *i*, fig. 1, 2, and 11, the use of which is to receive the two arms of a thin metal fork, G, which passes through them into the interior of the said metal chimney, F, and thereby supports the glass dome or chimney, D, by the selvage or rim at its upper extremity, as shewn in fig. 8, and 12, in the metal chimney, F, when the lamp, A, and its receptacle, C, are withdrawn. The fork, G, is retained in its place in the metal chimney, F, by means of the pin, H, fig. 1, 2, and 13, which is put through holes made in the upper part of one of the branches, *h*, and through the fork itself. When the glass chimney, D, is required to be removed, it may of course be done, by taking out the pin, H, and the fork, G; and may again be restored to its place in the metal chimney, F, by a contrary operation. To the upper part of the metal chimney, F, are fixed two hooks, *j*, *j*, fig. 2,

the lower parts of which are bent at right angles; and have each an hole in them, *r*, *r*, the use of which will be explained hereafter. By these hooks, *j*, *j*, the whole lamp and its reflectors (whose form and construction are more particularly described hereafter) are suspended to the cross-bar, I; which has the part represented between the said hooks, *j*, *j*, curved sideways, as well to prevent its hindering the free escape of the heated air from the lamp, as to determine the exact position in which the said hooks, *j*, *j*, must be placed on the said bar, I; so that the lamp may be suspended in the middle of the glass vase, J. The ends of the cross-bar, I, are bent downwards at right angles, and fit into loops, *k*, *k*, made in the metal rim, K, which supports the glass vase, J, and it is thereby kept in a proper position. From the lower part of the metal chimney, F, two hooks, *l*, *l*, fig. 2, project, which pass through two holes, *ɜ*, *ɜ*, in the wing-reflectors, L, L, and thereby support the extremities of the said reflectors, which are nearest to the metal chimney, F; leaving the opposite extremities of the said reflectors at liberty, to be elevated or depressed, as occasion may require. A circular portion of each of the said wing-reflectors is cut away, at the extremities nearest to the said metal chimney, F; so as to admit it to pass through, and suffer those extremities of the said wing-reflectors to come, as nearly as possible, in contact with each other; so that as many as possible of the rays of light proceeding upwards from the flame of the lamp, A, may be intercepted, and reflected by the said wing-reflectors, L, L. Projecting rims or ledges are also formed in these parts of the metal chimney, F, for the wing-reflectors, L, L, to rest upon. The said wing-reflectors, L, L, have also fixed to each of them a hook, M, M, fig. 1, 2, and 14, having a joint at *n*, *n*, and a female screw at *o*, *o*, into which screw the hooks, *p*, *p*; with the lock-burs, *q*, *q*, and these screwed hooks, *p*, *p*, being put into the holes, *r*, *r*, in the hooks, *j*, *j*, before mentioned, complete the supports or suspensions of the wing-reflectors, L, L, which, by means of the said hooks, *p*, *p*, may be raised or lowered at their

extremities, which are the farthest from the metal chimney, F, and so as to direct the reflected rays of light proceeding from them, either more horizontally, or upwards, or downwards, as may be required. When the wing-reflectors are brought into the required positions, they may be retained there, by means of the lock-burs, *q*, *q*, being brought into contact with the jointed hooks, M, M, at *o*, *o*, fig. 2. The glass vase, J, is fitted, with its cover, N, in the usual manner; and is held in the iron ring of the lamp-iron, by means of three or more metal straps soldered to the ring, K, two of which are shewn at *s*, *s*. In the bottom of the vase, J, is an opening, large enough to permit a man's hand to pass through, to put in or take out the lamp, A, in its receptacle, C. The vase has a metal rim, O, cemented to it; round which pass two projecting ledges, to hold the moveable metal ring, *t*, *t*. To this ring, *t*, *t*, is attached a hinge, *u*, of a plate of metal; or, in its stead, a ring filled with a piece of glass; which serves to close the said opening or aperture, and is capable of being turned round to any position at pleasure; that, when hanging down, it may screen the lamp from the wind whilst it is lighted. When shut up, it is retained in its place by the spring, *v*; and it has a ring at *w*, by which it may be pulled open.

We have been thus minute in our description of the preceding lamp and reflectors, not because all the minute circumstances of its construction, as we have described it, are equally applicable to lamps intended for every purpose; but for the purpose of conveying such an idea of the objects to which our improvements are directed, and the mode in which they are effected, as may put the public in the fullest possession of our invention, and enable them to derive every possible advantage from it, when the term of our said patent shall be expired *.

* Shortly after this patent was granted, Bond Street was brilliantly illuminated by these lamps and reflectors, and only one lamp employed where two had been before used. So complete was the light, that not only could the features of persons walking on the foot-paths be known, but also those of the company passing up and down the middle of the street in carriages.

The annexed drawing, No. II. plate 2, represents a Lamp for lighting rooms, halls, or other places, where its light is wanted to be equally diffused or distributed all around it, in a nearly horizontal direction; and which, therefore, instead of what we have called the wing-reflectors, belonging to the street-lamps, has a circular one.

The general construction of this lamp is very analogous to that of the one described in the drawing No. I.; and the same letters of reference likewise apply to this. We shall therefore have only to point out the different forms of some of its parts; for instance,—The body of the lamp, A, has no projecting piece, as at E, (see the drawing No. I.); nor is there any recess made to receive it in the receptacle, C, and E, for the purpose of fixing the exact position of the flame; it being quite indifferent which way it is situated, in regard to the circular-reflector. The receptacle may have a vase or other shape given to it; and there are several holes made in the extremities of the branches, *p*, *p*, descending from the metal chimney, F, (instead of one only, as in the drawing No. I.) in order to afford an opportunity of raising or lowering the ring, E, containing the lamp, A, in its receptacle, C; and by this means, placing the flame nearer to, or farther off, from the circular-reflector, Q; and, in consequence thereof, causing the reflected rays of light to be spread, to a greater or lesser extent, round and underneath the lamp at pleasure; and when the desired situation is found, it may be fixed there, by means of the two pins being put through the said holes, and other holes made in the two arms of the suspending ring, E, at *g*, *g*, fig. 1. The lower part of the metal chimney, F, is also made of a different form; not being shaped like that shewn in the drawing No. I. but cylindrical, with a ledge or rim projecting outwardly all round it, for the circular-reflector, Q, to rest upon. The places of the two metal hooks, *j*, *j*, are also changed, in order to suffer the said circular-reflector to pass over them, by means of the two recesses made in each side of the circular holes in the centre of the said circular-reflector, to permit the shoulders of the metal

branches, *h*, *h*, to pass through them, and thereby causing it to rest upon, and be supported by, the said ledge or projecting rim at the lower part of the metal chimney. By means of the two metal hooks, *j*, *j*, the whole may be supported underneath a metal or glass disk, which may prevent the smoke from injuring the cieling.

The mode of regulating a part of the air, to support the combustion of the material employed, is varied in this construction; the cap, *c*, being made entire, and the slits or holes for the air to enter at, being made at the lower part of the tube, C.

This lamp may be suspended and inclosed in a glass vase, similar to that shewn at J, fig. 1, No. I.: but when it is intended to be used within doors, the said glass vase is not necessary to be employed. And, more especially, by changing the construction of the air-register, C, to that shewn by figures 8 and 9, in this drawing, we oblige the air to pass into the tube, C, upwards, through its bottom, instead of sideways; and, thereby, prevent the flame from being disturbed by any accidental current of wind which might happen to arise.

In order to effect this; to the bottom of the tube, C, is fitted a plate of metal, having a hole in its centre; and one, two, three, or more other holes round its circumference, with spaces between them equal to their diameters; and another similar plate of metal, having like holes and spaces made through it, is placed either above or below the first-described plate: and, by means of an axis, which passes through the said plate, and is fixed to the second plate, and terminates below in a stud or knob, this last-mentioned plate can be turned round, so as to shut or open the said holes, and thereby suffer more or less air to pass through them, as may be required. In fig. 2, Q, is a plan of the circular-reflector, having the two recesses made on each side the central hole; and figures 3, 4, 5, and 6, Q, Q, exhibit four different sections through the centres of circular-reflectors; intended to shew some of the variations

made by us in our reflecting curves, according to the different purposes they are intended to answer.

Fig. 7 represents a Table Lamp for domestic or other purposes; which, likewise, having several of its parts made similar to those of the lamp last described,—and the same letters of reference applying to them,—it will be needless to do more, than to point out the variations to fit it for the above purpose, which are as follow:—The receptacle, C, containing the body of the lamp, A, made similar to that in fig. 1, just described, has its tube made longer, in order to elevate the flame above the table. To the lower part of it, a pedestal, R, is attached, in order to enable it to stand upon a table or other proper support; and the mode of regulating part of the air to affect the combustion of the oil, or other combustible substance employed, is by means of a moveable ring, S, which is fitted to the lower part of the tube; having holes, with spaces between them, equal to their diameters, made in it; and the lower part of the tube having likewise similar holes and spaces made in it, to correspond with those in the ring; so that, by turning the ring a little, either one way or the other, more or less air may be admitted as required, as in the other lamp lastly described. At T, are shewn two metal branches, which are fixed to the circular-reflector, Q; whose lower parts being received into two loops, made in the receptacle, C, support the said reflector; and this also keeps the glass chimney from falling. But when the lamp is used without the reflector, the glass chimney must be kept in its situation by means of the ring, connected with a proper branched metal support (shewn by the dotted lines), the two ends of which fit into the said two loops in the side of the receptacle, C. The lower part of the glass dome or chimney, D, is kept in its situation, upon the flat top of the body of the lamp, A, by means of three or more metal pins, fixed to the said body; two of which are shewn at *d*, *d*, and which apply themselves to the outside of the said glass dome or chimney, D.

[*To be continued.*]

II.—*Specification of the Patent granted to* WILLIAM BROCKEDON, *of Poland Street, in the County of Middlesex, Gentleman; for his Invention of certain Improvements in Wire-Drawing.—Dated 20th September*, 1821.

I, the said William Brockedon, do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the following specification thereof—that is to say:

Instead of the usual mode of drawing cylindrical wire, through holes made in plates of steel, iron, or other metals, or compositions of metals; I make, or cause to be made, by drilling or polishing, in the usual methods employed by lapidaries, &c. cylindrical or conical holes, with their extremities rounded off, through diamonds, sapphires, rubies, chrysolites, or any other fit and proper hard gems or stones; which I mount or set in blocks, frames, or plates of metal, or other fit substances, proper for fixing or securing them for use; and the metals, or composition of metals, to be made into wire, are to be drawn through these holes, in the usual manner of wire-drawing. The wire may be drawn through either end of the hole; but I prefer entering it at the smallest end, and drawing from the larger end of the holes; because the gems or stones will present, in this direction, a firmer resistance against the action of the wire, in drawing.

The holes in these gems, or stones, must be of successive sizes, according to the nature of the metal, or composition of metals, to be drawn into wire through them; and by which the wire is reduced, as in the usual way.

The wire may be of iron, steel, brass, copper, silver, gold, platina, copper silvered or gilt, or silver gilt; or any other metal, or composition of metals, fit or proper to be made into wire.

I do not point out any particular manner of adjusting

the blocks, plates, or frames, for the purpose of drawing wire; as that will be left to the judgment and discretion of the workmen usually employed in wire-drawing; the object of my invention simply being—the substituting of perforated gems, or stones, for making round wire; in place of holes made in metal draw-plates; as they afford the means of making each wire, so drawn, more perfectly equal and cylindrical throughout its whole length, owing to the hard substances, in which the holes are made, resisting the friction of the metal, in passing through the holes; whilst, at the same time, the holes themselves are less liable to become galled or enlarged by the wire in passing through them, than when made in metal plates.

III.—*Specification of the Patent granted to* GEORGE FREDERICK HAGNER, *late of Philadelphia, now of the Adelphi, in the County of Middlesex, Gentleman; for certain Improvements in the Art of making the Pigments, commonly known by the names of White Lead, and Verdigris.—Dated 27th January,* 1818.

I, the said George Frederick Hagner, do hereby declare, that my said improvements in the art of making the pigment, commonly known by the name of white lead, consists in the use of a machine or machines for granulating lead; and which said machine may be a revolving cylinder, or other proper vessel, turning upon axles, and having an opening at one end of it, into which melted lead may be poured: and, after being granulated, by the rotary action of the machine, may be readily discharged, by causing the vessel to be inverted, or the opening at the end of it to be turned downwards; this may be effected in various ways, not necessary to be particularly described; and the lead, so granulated, may be afterwards used with advantage in the manufacture of white lead.

My said improvement in the art of making verdigris,

consists in the use of a machine, or machines, which may be a revolving vessel or vessels, turning upon axles; or other proper vessels capable of receiving an alternating motion, or of being agitated; as also of fixed vessels, in which agitators may be put into motion. Into any, or either, of these vessels, I put copper, in a state of division, the more minute the better: and I add to the copper, pyroligneous acid, vinegar, or other acetic or acetous acid; and either mixed with water, or not, so as that the copper shall only be partially covered by the liquid; and I cause the same to be put into continual agitation, by any proper first mover, so as to present fresh surfaces of the metal to the acid, and to abrade or rub off those parts of it which may be sufficiently oxided.

In case the vessel or vessels be wholly, or in part, closed; I introduce carbonic acid gas, during the operation of the machine; and I continue the process for a greater or lesser period, or until the verdigris is formed; when it may be withdrawn from the vessel or vessels, and finished for use.

IV.—*Specification of the Patent granted to* WILLIAM EVETTS SHEFFIELD, *of Somers Town, in the Parish of Saint Pancras, and County of Middlesex, Gentleman; for an Improved Apparatus and Furnaces, for separating Metallic and other Substances from their Ores, or whatever Matters may be combined, united, or mixed with them; and in the application of the same.—Dated* 31*st Oct.* 1812.

WITH FOUR PLATES.

I, the said William Evetts Sheffield, do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in manner following;—that is to say: First, my said improved apparatus doth consist of two portions or parts; namely, one portion or part thereof

is called an air-conductor; and is to be applied to, or constructed in and along with, a furnace or furnaces; and to be therewith used, for the purpose of introducing, into direct contact with the ores or other materials to be exposed to the action of heat in the said furnace or furnaces, atmospheric air, or any other gas or elastic fluid, which may be found or considered to be useful in, or as to the treatment of, the said ores or materials; as more particularly is hereinafter shewn. And also, namely, one other part or portion thereof, which is, an improved pot or vessel, for the beneficial separation of zinc, in the metallic state of the ore. And, Secondly, my said furnaces are constructed for the like purpose of beneficially separating metallic zinc, and other substances, from the ores thereof. And the same are specially set forth and explained in and by the drawings hereunto annexed.

Fig. 1, plate III. represents the vertical section, and fig. 2, the plan, of a reverberatory furnace, to which my said air-conductor is adapted; and the said conductor affords an aperture, expressly fitted and adapted for introducing the external air, over and above, and in addition to the air which passes through, and is deprived of oxygen by the fuel. And the said air-conductor may be placed in any part of the furnace best suited to the nature of the operations to be performed therein: but, in the present drawing, it is represented in that part of the furnace called the bridge, which is best suited for the reverberatory furnace, because the atmospheric air from the conductor will be, by that means, directed over the materials spread on the bottom of the furnace, into the stack or chimney at the other end. But in the furnace for making red lead, the air-conductor should be placed in the back wall, or opposite the door or entrance of the furnace. And in the said figures 1 and 2, the letter *a* represents the tube, or leading part of the air-conductor; and *b*, the aperture or mouth of the same; which aperture may be made wide in its horizontal dimensions, in order to spread the air; *c*, *c*, is the hearth or floor; *d*, the

chimney; *e*, the ash-hole and fire-place. And I do allow, admit, or regulate, as may be required, the introduction of air, by means of a cock, or register, or slider, or other similar piece or construction, applied to or forming part of the said apparatus*.

*** ***An apology may be necessary to our Readers for breaking off in the middle of an Article. They will perceive that it is the least of two evils, to confine the letter-press to the same Number which contains the Plates. The same remark applies to Article I.***

V.—*Specification of the Patent granted to* GEORGE SHOOBRIDGE, *of Hounsditch, in the City of London, Woollen Draper; and* WILLIAM SHOOBRIDGE, *of Marden, in the County of Kent, Farmer; for a Substitute for Flax and Hemp, and for Manufacturing the same for all purposes for which Flax and Hemp are used.—Dated 5th Feb.* 1820.

WE, the said George Shoobridge and William Shoobridge, do hereby declare, that the nature of our said invention and the manner in which the same is to be performed are particularly described and ascertained as follows; that is to say: Our said substitute for flax or hemp is the fibrous substance which nature produces between the pith or core and the outer bark or rind of the hop-bind; and the said fibrous substance is separated from the said pith or core, and from the said bark or rind; and is manufactured or made fit for the purposes to which flax or hemp are applied, in the following manner:—First, we take the hop-binds in their green state, immediately after the hops have been gathered; and we cut them into lengths of about four feet (or more or less); and when so cut into lengths, we tie them up in bundles of any size convenient to be handled, and not too large for the depth of the water into which they are to be immersed, as hereafter described. The sooner this is done, after the hops are gathered, the better, as the difficulty of afterwards separating the fibrous

* For the application of this *patent air-conductor* to the purpose of *consuming smoke*, see Article IX.

part is increased, if the hop-binds are suffered to dry before the process commences. Secondly, the said bundles, without suffering them to dry, are to be immersed in hot or boiling water, in vessels of sufficient capacity, and kept in hot or boiling water till, on the trial, the fibrous or flaxy part is found to separate easily from the pith or core; or, which is a more economical method than that which we usually follow, the said bundles of hop-binds, cut into lengths as aforesaid, are immersed in running or in standing water, the softer the water is the better it answers, and are kept under the same by stones or weights laid upon them till, on trial, it was [is] found that the fibrous or flaxy part can be easily stripped from the pith or core. This is seldom effected in less than eight days; and sometimes it requires two or three weeks, according as the hops have been suffered to remain ungathered for a longer or a shorter time by favourable or unfavourable weather, and depending also on the quality of the water in which the bundles are immersed. Thirdly, when the steeped hop-binds are found ready for the process, the fibrous or flaxy substance is, along with the outer bark or rind, separated from the pith or core in the following manner:—posts, or benches, of heights convenient for the men, women, and children employed, are provided; into these are driven iron nails in pairs, or pieces of iron in pairs, presenting angular edges in such a manner, that the tops of the said nails or pieces of iron shall stand a few inches above the posts or benches in which they are fastened, and be close at the bottom, and a little open at the top of each pair, something like the letter V, but not so wide in proportion in the upper opening. To these pairs of nails, or pieces of iron, we give the name of strippers, and they are used as follows:—the work-people take the pieces of hop-bind by one end, one or two pieces at a time, and placing them in the strippers, which they enter to a greater or less depth, according to their respective sizes or diameters, the work-people draw

them through the strippers, more or less often, till the fibre and bark is [are] stripped from the pith or core, and drawn up in balls or lumps at the back [backs] of the strippers. Fourthly, the said balls, or lumps of fibre and bark, are taken off from the back [backs] of the strippers as quickly as they are produced, by women or children, whose business it is to draw them out again into length [lengths] with their fingers, and to lay them down, in order that they may, when dried, as hereafter directed, be in a fit state for the subsequent manipulations. Fifthly, when the fibre and bark have been disentangled from the lumpy state in which they are found at the back [backs] of the strippers, and brought into longitudinal arrangement, they should be taken up in convenient handfuls, and rinced in water to separate as much, as can in this way be separated, of the vegetable gluten or mucilage which adheres to the fibre. Sixthly, the fibrous or flaxy material thus separated from the pith or core, and rinced or washed, as has been directed, is to be spread out to dry in the sun and air; or, if the weather be unfavourable, on hurdles or any kind of shelves made under sheds, or it may be dried by stoves or on kilns. The sooner this is done the better. Seventhly, when thoroughly dry, the fibrous material is beaten by the hand with mallets, batons, or rods, or any other means, for the purpose of breaking and reducing the bark or rind that still adheres to it to a state of powder; a great part of which may then be shaken from the flaxy fibre, which is then to be dressed by hackling, or all or any of the usual means employed to dress and prepare hemp or flax, for the different purposes of manufacture. Eighthly, when we wish to obtain the fibrous substance in its longest state, which is more useful for some purposes of manufacture; then, instead of drawing the steeped hop-binds through the strippers, as before directed, we cause the work-people to peel off, by hand, the fibrous substance, with its rind, which is then to be dried, and afterwards beaten and dressed as before directed. We have only further to

remark, that we do not, by any thing before stated, mean to claim as our invention or discovery, that nature produces a fibrous flaxy substance around the pith or core of the hop-bind, that fact having been long known, and the hop-bind having in consequence been applied to the purpose of making coarse paper, and perhaps to other uses*; but only, and exclusively, that the said fibrous or flaxy matter, when properly separated from the pith, and properly dressed, may be brought to that state of fineness and purity which shall render it a fit substitute for flax or hemp; and that this may be effected by the means before described.

VI.—*On Substitutes for Hemp and Flax, and on Manufacturing Cloth from Hop-Binds*†.

IN the year 1760, the Society offered premiums for making cloth from hop stalks or binds, and subjoined to the advertisement some directions to be pursued in preparing the stalks, and obtaining the fibres in a fit state for manufacturing. No proper claim was ever made for these premiums: but as the want of success seems to have arisen, not so much from the impracticability of doing it,—the practice being known, and in use in Sweden,—as from the want of proper information respecting the conducting the process; it has been judged proper to print the following letter, which may serve to stimulate ingenious persons to make further trial of a material produced in such great quantities in this kingdom, and hitherto employed to no profitable purposes; and, as a still greater inducement, the Society have again offered a premium for the making cloth from hop-stalks.

The process alluded to in the following letter, was published by the Society in 1760, as follows:—

* See the following Article.

† From Vol. III. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce, page 139.

" The hop-stalks or binds are to be collected in autumn, " put into water, and covered therewith the whole winter; " in March they are to be taken out, dried in a stove, " and dressed as flax. The prepared filaments will be " fine, soft, and white, and may be spun into cloth: hop- " stalks require a longer time to rot than flax; and if not " completely macerated, the woody part will not separate, " nor the cloth prove white or fine."

But these directions having been found inadequate to the purpose intended, the Society, in some subsequent publications, added the following *nota bene* to their advertisements:—

" It not being exactly known how long time the hop-binds " require to be steeped in water, in the manner hemp is, " in order to separate the fibrous parts from the rest; it is " recommended to the candidates for the premium to exa- " mine the hop-binds, from time to time, during their steep- " ing, and to take them out before the fibres appear to be " too much weakened for the use intended; they are then " to be dried on a kiln, or in some other way; and it is " required of each candidate to produce to the Society an " exact account of the manner of treating the hop-binds."

SIR, *London, December* 14, 1761.

Having attempted the making cloth from hop-stalks, in pursuance of the premium and process published by the Society, I have, by desire of several members, left some specimens of the manufacture with the Registrar, I beg leave to trouble you with an observation or two, that may be proper to be attended to if this subject should again be taken into consideration.

First, That the said specimens are sufficient to evince that hop-binds will afford a material for making cloth.

Secondly, That the species of cloth intended to be made

from the material produced, would answer very well the purpose of fine sacking, and coarse bagging for hops.

Thirdly, That the sole cause of my not producing a stronger material, and a sufficient quantity to have entitled me to the premium proposed, was, that the material was too long immersed under water, and its texture was thereby destroyed.

Fourthly, That such binds as I took occasionally from the large quantity I had put to soak; at the end of about six weeks or two months, afforded filaments sufficiently fine and strong for any purpose.

Fifthly, That the time necessary to reduce the inner substance of the hop-binds to a fitness for use by maceration, will absolutely decay the outer coat, as appears from those which have continued under water above a year.

My attempts and endeavours in this matter fall very short of the success and perfection hoped for by the Society and myself, and allow me no pretence for claiming the premium proposed.

I am, Sir,

Your most obedient humble Servant,

H. COOKSEY.

To Dr. Templeman, Secretary to the Society for Encouragement of Arts, Manufactures, and Commerce.

The following extracts from the Ninth Volume of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce, will shew their further endeavours to bring this important manufacture into general use. In the Preface to that volume we find the following observations:—"In the class of Manufactures, a claim has been "made, and the premium adjudged, for manufacturing a "quantity of cloth from hop-stalks. It is many years since "the Society received information that the stalks or binds "of the hop furnished a material for a strong and useful "cloth, and that they were employed for that purpose in

" Sweden. As one main intention of this Institution is to " convert refuse materials to useful purposes, the endea- " vouring to establish a manufacture of cloth from hop- " stalks, which have hitherto been considered as fit only " for fuel, or the dung-hill, may well be deemed a matter of " national importance.

" The twenty-five yards of cloth produced in claim of " the premium were, as might be expected at the com- " mencement of a manufacture, of a coarse kind, fit for " sacking, hop-bagging, or other inferior uses; *but a small* " *piece, shewn by the same candidate, finer spun and closer* " *woven, gave reason to believe, that, by due management, a* " *cloth may be formed from these stalks applicable to many* " *useful purposes.* If on further trial this should prove " true, the public will see another benefit arise from the " continued and well-directed premiums offered by the " Society; from whose endeavours and perseverance many " of the improvements that have taken place of late years " must be allowed to have proceeded."

In the class of Manufactures is the following communication, page 143:—

In consequence of information received many years since, that a strong cloth was made in Sweden from hop-binds, a premium was offered by the Society for preparing that material, hitherto a refuse one, and manufacturing it into thread and cloth in these kingdoms. At length the object has been accomplished; and a claim being this year made, and proper samples and certificates produced, the premium, TWENTY POUNDS, was adjudged to Mr. JOHN LOCKETT, whose account of the manner of manufacturing the hop-binds is contained in the following letters:—

Donnington, near Newbury, Berks,
December 12, 1790.

SIR,

I herewith send to the Society for the Encouragement of Arts, Manufactures, and Commerce, a piece of

cloth made from hop-stalks, in claim of the premium for that article: the cloth would have been evener, if time had permitted me to have examined the material, and the proper mode of preparing it.

I am, Sir, your humble servant,

JOHN LOCKETT,

Manufacturer of Linen and Cotton.

Mr. More.

SIR, *Donnington, Jan. 30, 1791.*

Agreeable to the request of the Gentlemen of the Committee of Manufactures, I have sent my method of working the hop-stalks, though far from thinking it perfect: they were cut in lengths, of about two or three feet, put into a furnace, in which was some lie that had boiled linen in for bleaching; then boiled till the rind separated from the stalk easily. When cool, they stripped so freely, that children might do it; and the yield was great, in proportion to the quantity of stalks. I then followed the same method as in working hemp or flax; but I find it much more stubborn than either, therefore not so well adapted for fine cloth; and the fibres are so united with an adherent matter, that they do not easily separate; but for sacks, cordage, &c. it may be of great service.

I had some of it hackled while it was wet, soon after taken off; but it did not separate the fibres. Carding seems to work it best, and make it like cotton. Of the piece of cloth I have sent, the warp is hackled, and the woof carded. I am now going to prepare some more, and will send you some of it in its different states, which will be a proof that what I have sent is really from hop-stalks; but if that should not be a sufficient proof, I will send the deposition of the persons who wrought it. The colour of it is natural, and it is so impregnated with it, that I believe it will not bleach without great difficulty, which I intend to try this spring.

The liquor the stalks were boiled in was so strongly

coloured, that I thought it might be of some use in dying*. I have now written the little I know about hop-stalks, and am ready to answer any questions to the best of my knowledge.

I am, Sir, your humble servant,

JOHN LOCKETT.

Mr. More.

We the undersigned, William Harris, of the tithing of Donnington, in the parish of Shaw, in the county of Berks, flax-dresser, and Matthew Deale, of the same place, weaver, servants and workmen of Frederick Cowslad, of Donnington, aforesaid, esq., under the direction and inspection of John Lockett, of the same place, linen-manufacturer and draper, do make oath, and say:

That during the months of October, November, and December last, they (with others) pealed the rind off a quantity of hop-vines, at Donnington aforesaid, having first boiled the same for that purpose, and afterwards dressed it in the manner of flax; which hop-vines were afterwards spun into thread, by divers persons in the said tithing of Donnington, who these deponents daily saw at work thereon, until the same was put into the loom.

And this deponent, the said Matthew Deale, maketh oath, that he did afterwards weave the said thread, so made of hop-vines, into a piece of cloth, of the colour of tanned leather, which the said Matthew Deale afterwards delivered with his own hands to the carrier in Newbury, in order to be conveyed to the Honourable Society established for the encouragement of Arts and Sciences.

And both these deponents make oath, and say, that the said piece of cloth, containing twenty-five yards in length, was daily seen by them while spinning; and also in each other's hands; and that it was made wholly of hop-vines, without any mixture or composition whatever, and with-

* Hops are now largely used in dying.—EDITOR.

out any fraud or evil practice, with a view to obtain the bounty offered by the said Society.

WILLIAM HARRIS.
MATTHEW DEALE.

Sworn before me, one of his Majesty's justices of the peace for the county of Berks, the 17th day of February, 1791, C. DUNDAS.

VII.—*An Essay on the Devastation of the Gums, and the Alveolar Processes. By* L. KOECKER, *Esq. Dentist, Honorary Member of the Philadelphia Medical Society, &c.**

THIS disease, I suspect, is far from being accurately understood, and is generally supposed to be incurable. The remarks which I am about to offer on it, are the results of close practical observation; and as the subject is of no inconsiderable importance, they may not, perhaps, prove either useless or unacceptable.

In his Natural History of the teeth†, Mr. Hunter says, "How far these diseases can be prevented and cured, is, I believe, not known." Fox ‡ differs very little from Hunter on this point. He speaks of the affection in so vague a manner, and so much so, indeed, of its cure, that I am inclined to believe he never saw one effected, at least when it had advanced to any considerable extent. At all events, I feel persuaded that the subject has not been considered with sufficient attention by those writers who have come under my notice §.

* From the Philadelphia Journal of the Medical and Physical Sciences, No. 4. for August, 1821.

† Vol. I. p. 51. ‡ Natural History, &c. part ii. p. 95.

§ The late Dr. La Roche informed me, that he had seen this disease very frequently in the French colonies, and in persons of different ages; that its progress was very rapid; and that it was generally considered peculiar to the climate, and altogether incurable.

In 1812, during my short practice in Lancaster, I saw a gentleman, aged about forty-five years, who had been deprived of the use of all his teeth from this disease. He shewed me about twenty which were tolerably

This disease I have met with in its different stages, and have always succeeded in curing it by the mode of treatment which I am now to describe.

Cases of this nature have their beginning, generally, in an inflammation and suppuration of the gums, which gradually extend to the periosteum of the alveolar processes, and of the teeth: or they begin by an inflammation of these parts, which is afterwards communicated to the gums. They very rarely originate in the alveoli themselves.

The inflammation and suppuration are sometimes violent, and the absorption goes on rapidly, while in other instances it is so slow in its progress as to be scarcely perceptible, and the suppuration destroys the gums in a very gradual manner, attended by the absorption of the alveoli and their periosteum. The teeth, now losing their support, become loose, and drop out successively.

The disease seldom attacks all the alveolar processes at once, but generally begins at some one part of the mouth. I have seen it commence at the incisores, though more frequently at the molares.

The crowns, necks, and particularly the exposed parts of the roots, are frequently covered with a greenish glutinous substance, and with adhering tartar. The spaces between the teeth are filled up with a tartar of a dark brown or greenish colour, but sometimes of the usual appearance; and, in other instances, I have even seen them so clean as to deceive a superficial observer; but a close examination has invariably found some tartar adhering to the roots, and pressing upon the alveolar processes, hid under the edges of the gums, and in the spaces between the teeth.

The gums are, for the most part, much swelled and inflamed, attended by a thin pus-like discharge from between

sound. He mentioned that eight years had passed before the whole were lost; during that period he suffered much pain, and enjoyed neither peace nor comfort till he was deprived of every tooth. He was so contented with the relief which the entire loss of his teeth occasioned, that my proposition to supply him with a set of artificial ones was rejected without the least hesitation.

them and the roots of the teeth, occasioning an offensive smell. These parts sometimes exhibit a pretty healthy appearance, though never, as far at least as my experience extends, perfectly free from inflammation, as Hunter and Fox have stated.

As already intimated, this disease, frequently in the beginning, proceeds very slowly, and often affects only certain parts of the gums for many years. When once, however, it becomes general, it goes on with such rapidity, that while one tooth is dropping out, others are so loose, that the slightest pressure, almost, will make them fall from their sockets.

Persons of robust constitutions are very liable to this affection of the gums, and it shews itself oftener after the age of forty than any other time. Their teeth are many times perfectly sound, or very little affected with caries, though I have occasionally met with them considerably diseased and painful.

Among other remote causes of the disease, may be enumerated a scorbutic and scrofulous habit affecting the gums; the frequent and inordinate use of mercury; great irregularities in the position of the teeth; neglect of cleanliness; smoking and chewing of tobacco; operations of different kinds injudiciously performed: such, for example, as the filing of the teeth, when the general state of the mouth, from an imperfect healthy action, is not capable of bearing the unavoidable irritation which it occasions; or, where too great violence is used in this operation, even in a healthy state of the mouth. Certain tooth-powders may also be mentioned, as charcoal, from the irritation which it mechanically excites in the gums.

By the above causes, a collection of tartar, without which I have never seen this disease, is deposited upon particular parts of the teeth, and this becomes the immediate or exciting cause of the disease; and, so long as it is suffered to remain, entirely prevents the success of such efforts as nature may make for the accomplishment of a cure.

When the disease has advanced considerably, and some of the teeth have already become much exposed and loose, they prove another and a more powerfully aggravating cause. The disease having, therefore, proceeded thus far, it may be considered as near its height, since the teeth will now fall out one after the other, till they are all lost.

The mode of treatment consists, first, in checking the diseased action which has become habitual, and in producing a general healthy disposition in the diseased parts, and those connected with them, by removing the exciting causes; and, secondly, in preventing their recurrence.

The first indication is realized by extracting such teeth as are too much affected by the disease to be capable of permanent restoration, and by a complete removal of the tartar and glutinous matter covering the remaining teeth and their fangs, which produce the irritation in the alveolar processes. The second indication is met by removing such remote causes as may still exist; or, if this cannot be done, by counteracting their influence. When of a general character, such as from scurvy, scrofula, or the effects of mercury, constitutional remedies combined with topical means are required. Being local, however, that treatment to which I now beg leave to draw the particular attention of the reader is only demanded. The remedies prescribed for the removal of the causes mentioned, are of very great importance. Considerable irregularity of the teeth existing, such teeth as excite, from their unnatural situation, a constant irritation, either in the opposite teeth or upon their gums and alveoli, should be removed, and thus the effects of their irregularities prevented. Operations injudiciously performed require such remedies as will remove the injurious effects resulting from them. The individual having been entirely neglectful in cleansing his teeth, or where this has been done in an improper manner, more careful attention, under the direction of a skilful dentist, to these circumstances, will be demanded, in order to prevent the re-accumulation of tartar.

With the foregoing measures may be combined some astringent or tonic washes, such as the diluted tincture of Peruvian bark and myrrh, which I have found very serviceable.

Considerable experience and judgment are required to discriminate, at once, between those teeth which may be capable of preservation and such as ought to be extracted.

The principal and fundamental curative means in the disease of the alveolar processes, are the removal of teeth so much injured from the effects of the disease, as to have become a direct exciting cause to its further progress; as well as of those which are at the moment, from a variety of circumstances, indirect causes, and must unavoidably become, in the progress of time, sources of the irritation and morbid condition of the surrounding parts. The disease, therefore, being so far advanced as to render it necessary to extract some of the teeth, this operation must precede every other remedial attempt, since, omitting this, a cure is impossible; and all other operations not only prove fruitless, but have an immediate tendency to increase the irritability of the affected parts, and the violence and rapidity of the disease itself.

It is hence a matter of considerable moment to establish some guide, as far at least as the intricacy of the subject will allow, by which we may be directed in deciding upon those circumstances that ought to induce us to extract the teeth, or to make efforts to preserve them. In such an estimate, the weight which a number of considerations of a minute and incidental character should have upon the determination and conduct of the operator, must be left very much to his own judgment and experience.

The incisores and cuspidati being the most important teeth, the main attention is always to be directed to them. They are, fortunately, from their natural situation, and from their peculiar formation and functions, not only the most favoured, but they are besides capable of suffering more from this disease, without being destroyed, than the other

teeth. They may, indeed, be preserved, even when not more than one half of the alveolar processes remains, provided that a considerable portion of the fang continues united to the alveoli by its periosteum. I would always endeavour to preserve them unless they were very loose. More, however, than one half of the alveolar cavity being absorbed, and where the tooth is very loose, or has lost its vitality, it must be extracted for the benefit of those adjoining.

The bicuspides and molares are much less favourable for preservation than those just mentioned, and the process of mastication imposes on them a greater mechanical irritation. They are also more inconveniently situated and formed, and generally have several roots, in consequence of which the difficulty of keeping them free from tartar is not a little increased.

They should be extracted: First, when they are very loose; I consider teeth in this state a direct cause of disease, from the constant irritation which they occasion to the alveoli: secondly, when the alveolar processes have receded from them so much as to expose the spaces between the fangs of the teeth, since then it will be impossible to prevent the re-accumulation of tartar in these places, which inevitably continues the disease, and from which such teeth are to be considered its indirect causes. The suppuration cannot fail to be sustained by the irritation of the tartar, until the tooth becomes loose, and is then, itself, both a direct and indirect exciting cause of the disease.

No one of the molares should be permitted to remain, where it has no antagonist, particularly if it is situated in the upper jaw. The utility of such teeth is destroyed for want of an opposing surface to act upon, and they have, therefore, an influence upon the surrounding parts not unlike an extraneous body. As for instance: should there be by accident an interval between two antagonists when the jaw is closed, nature uniformly attempts to remedy the evil. The cavity of the alveoli in the first place contracts at its bottom, and drives out the tooth until it meets its opponent,

by which the necessary stimulus is restored, and the morbid action cured. If a tooth is lost entirely, it produces in a similar manner the destruction of the one opposite. This long struggle of nature, at last, will involve in a greater or lesser degree all the other teeth in a like morbid condition. It is necessary, therefore, to end it by extraction.

Every tooth that has lost its vitality, as well as every stump, should be taken away, and also those teeth, which from an irregular situation or direction, excite a mechanica irritation.

Teeth, to be removed, must be extracted with great skill, and all at the same sitting, because it would almost obviate, or at least greatly lessen, the desired effects, if the operations were performed at different intervals. This advice is the result of much experience, and merits, I think, some consideration. The bleeding from the sockets should be encouraged by warm water taken into the mouth at short intervals, during the different operations, and continued for some time, as the effects are of much importance. A gentle astringent wash may be subsequently employed for several days. I have generally found the following simple preparations the most useful.

℞ Mel Despumat. ʒ iij
Acid. Vini. ʒ j

This diluted, in the proportion of three table-spoonsful to a pint of warm sage tea or water, and used frequently during the day.

℞ Mel Despumat.
Tinct. Cinchon. ā ā ʒ ij
Mix, and dilute as above.

℞ Mel Despumat.
Tinct. Myrrh, ā ʒ ij
Mix, and use as above.

℞ Mel,
Tinct. Catechu. ā ā ʒ j
Mix, dilute, and use as above.

In about ten or fourteen days after the removal of the teeth, the inflammation is found considerably subsided, the gums assume a more healthy appearance, and the teeth grow in a corresponding degree firmly in their sockets.

The tartar should now be removed; and there is often much difficulty in doing this well. It adheres so firmly to the necks and roots of the teeth, which are generally more or less loose; it is attached so closely to the alveolar processes, and is in many cases so covered by the edges of the gums, and so hid between the teeth, that it is not without the utmost care we are able to avoid irritating the gums and periosteum with the instruments employed. The operation on this account is to be performed with the greatest caution and delicacy, in order as well to remove the tartar perfectly, as to avoid making the teeth still more loose.

Instead of believing that the removal of all the tartar at the same time can endanger the teeth by exposing them, as asserted by several writers, it seems to me, when it can be effected, the sooner they are relieved from such a pernicious coat, the more we contribute to their preservation. Yet we are in this case oftentimes under the necessity of contenting ourselves with the removal of a certain portion at once, and finish the remainder after a lapse of eight or ten days. As the tartar is most injurious in those parts where it presses upon the alveolar processes, it is highly necessary that every particle of it should be removed.

After the stony matter, or hard tartar, has been taken away, the removal of the green mucus is still an important part of the operation. This cannot be effected with instruments. It may be done by dipping a piece of thick sole-leather or soft wood into some abrading tooth-powder or dissolving liquid, and then rubbing the surfaces of the roots and crowns of the teeth with it, to be followed by the use of a soft brush. The dentist's care is now to be directed to the prevention of the re-accumulation of the tartar. Not only on this does a perfect cure almost entirely depend, but also the prevention of its recurrence. To effect this pur-

pose, however, with satisfaction, is found quite an arduous task.

There is always much predisposition to form new tartar, and the difficulty of preventing it from settling on the teeth and fangs, is augmented by the great irritability and tenderness of the gums, the debilitated state of the periosteum, and the inflammation in the alveola.

The frequent repetition of scaling the teeth with instruments, cannot prove a substitute for not keeping them clean. It has, on the contrary, a tendency to maintain great irritation, and the benefit derived in this way, without proper care afterwards, can only be temporary.

Mechanical means alone are, for the most part, either insufficient or too violent, and powerful chemical means are apt to produce such diseases in the teeth as will destroy them in another way. The only method, therefore, which remains, is to use these means combinedly, by which the bad effects may be avoided, and the advantages of both obtained. The rule to guide us in applying these remedies is, the further the disease is advanced, the more the chemical agency is indicated, and the less is mechanical power to be applied, and conversely.

Having scaled the tartar from the teeth with instruments, I adopt the following plan: I request the patient to brush his teeth in the morning, and after every meal, with an astringent powder, possessing a sufficiently abrading power upon the tartar, and with a brush not so hard as to create much pain. After this process has been continued for about four weeks, and the accumulation of tartar found to be diminished, I direct the powder to be used in the morning and evening only, and the brush and water after every meal. The brush should neither be too hard nor too soft, and so formed as to clean the spaces between the teeth, and to give that mechanical stimulus to the gums which is so highly beneficial.

The internal gums are considerably harder and less irri-

table than the external, a fact which has not been noticed, at least as far as my observation extends, by any writer.

Tartar accumulates much more rapidly upon the inner, than on the external side of the teeth; and hence a different brush for each surface is required. That for the internal side should be made of the best hog's bristles, and cut from five-eighths to three-quarters of an inch in length: while that for the external is to be made of the best loose hair, and cut about half an inch long at the commencement; and, as the disease decreases, it may be used a little shorter and harder.

The patient should be directed to press as hard with the brush as he can bear against the gums and teeth, so that its bristles may insinuate themselves into the spaces of the teeth, and between the edges of the gums and the roots of the teeth. The pressure of the brush to be applied in the direction from the grinding surface of the teeth towards their roots, so that the mucus which adheres to the roots under the edges of the gums may be completely detached.

The mode of brushing the teeth which I direct to be adopted, is entirely the reverse of that recommended by every writer on the subject whom I have consulted. They all advise, that the brush should be applied from the gums towards the teeth, the consequence of which is, that the tartar remains fixed close to the alveolar processes, and that some mucus is pressed into the spaces at each brushing. The intention they have in advising the brush to be thus used, is to excite the gums to grow over the roots again; but so far from this being effected, much injury is sure to follow this practice. There is a natural tendency in the edges of the gums to get their proper place, provided every thing that can interfere with this effort be carefully and constantly removed.

By Mr. Hunter, very good effects are expected from scarifying the gums repeatedly—and Fox places still more reliance on the advantages of this operation. To me it has always appeared as affording only temporary relief,

and to be of no real benefit in permanently arresting the progress of the disease. It should, I think, be discarded; since, though palliative in its immediate tendencies, it will occasion delay in the use of a more effective treatment, and therefore must, in its ulterior consequences, be considered as absolutely pernicious. By the extraction of one tooth whose removal is indicated, we do more good than by fifty scarifications—and if the disease be not so far gone as to require the extraction of any teeth, the immediate removal of the tartar has the same effect. If there is any inflammation in the gums, the mere pressure of the instruments on them in scaling the teeth, must unavoidably occasion some bleeding, which, together with the removal of the exciting cause (the tartar), answers more directly and more permanently, than any scarifications for the removal of the inflammation.

The practice of fastening such teeth as are very loose by ligatures to their contiguous teeth, as recommended by Fox, is still more injurious, and should never be resorted to, even where a radical cure is no longer to be looked for.

Teeth which are fit for preservation, will grow again by restoring the tone of their periosteum and the other surrounding parts,—and this is to be effected by the remedies already indicated. The ligature not only prevents the loose teeth from growing firm again, but also tends to loosen those to which it is attached, for the following reasons: The gold wire, however thin and pure, has not sufficient flexibility to permit the loose teeth to grow in their natual situation, or to be applied without some irritating pressure on the gums and adjacent teeth. The ligature made of silk has the inconvenience that it will contract when it becomes wet with the saliva, and thereby impose a constant straining upon the teeth.

The operations which are necessary to be performed on decayed teeth, such as plugging, filing, or cutting out carious parts, must be deferred, until the parts have acquired health and vigour to support the irritation which

they cause *. Artificial teeth should, if possible, be avoided, and only made use of under imperious necessity, and prepared with the greatest care and accuracy, in order to prevent any injurious mechanical influence upon the gums and those teeth which come in contact with them.

CASE.

On the third of May, 1818, Mr. P. from Baltimore, consulted me on the subject of his teeth. On examination, I found that he was labouring under the affection of the gums already described. Nearly half of the alveolar processes of the incisores and cuspidati of both jaws was destroyed: those of the upper, rather more than those of the lower. The teeth were a little loose. The alveoli of the second molares of both jaws had suffered almost as much as those of the incisores. The latter were not loose, but the partitions of the alveolar cavities between the roots were so much absorbed, that I could pass a probe between the roots. Those of the upper dentes sapientiæ had not suffered so much, and the antagonists, the two under dentes sapientiæ, were the only two teeth which the patient had lost. The alveoli of the bicuspides and of the first molares had suffered less than any other. Their roots were about one-eighth of an inch exposed. The gums were slightly inflamed, and there was a small discharge of a whitish matter all round their edges, from between the fangs of the teeth and the edges of the gums.

The patient had always paid a good deal of attention to cleanliness, and there was, therefore, not much tartar on the teeth; yet they were not entirely free from it, and particularly the fangs, to which there was a considerable portion adhering close to the alveolar processes. The teeth were all tolerably healthy, and but one had been painful.

* I have always delayed such operations for at least three months. An attempt too early to perform them may not only bring on a relapse of the disease, but would probably prevent the successful results of the operation.

They were well and handsomely formed, and regular in their position, with the exception of the first under bicuspis on the right side, which was pressed outwards and acted unnaturally upon the opposite cuspidatus and first bicuspis.

The gentleman was about thirty-two years old, and of an excellent constitution, and had, never to his recollection, been sick even a single day.

About three years prior to his consulting me, he applied for advice to one of the most respectable dentists of Paris, who, after examining his teeth, told him that his mouth was labouring under the consequences of venereal disease, and advised him to apply to a physician. The gentleman, however, assured him that this was impossible, as he never had the slightest taint of a venereal character. The dentist persisted in his assertion; and told him that the state of his gums rendered his opinion altogether certain, whatever the patient might declare to the contrary. Disgusted with such ignorance and presumption, the gentleman left him, but neglected to take any further advice.

Several weeks before I saw him, he was forced, from a violent tooth ache, to apply to a dentist in Baltimore, to relieve him from this distressing affliction. The dentist, however, refused to extract the tooth, alleging, that its removal was unnecessary, as the patient would, in a few years, lose all his teeth.

The gentleman forgot his pain, left the dentist by whom he was much alarmed, and resolved to consult me on the subject, which intention was immediately communicated by letter.

When I saw him, I conceived that I hazarded nothing by the assertion, that I had very great hopes of preserving all those teeth which were the most important. I found him perfectly willing to submit to any plan of cure which I should see proper to adopt. I therefore extracted the two upper dentes sapientiæ, which had lost their antagonists; the four second molares, the roots of which were so much exposed as to preclude every hope of success in at-

temping to save them; and the first bicuspis of the right side, the irregularity of which has been noticed. Nothing but warm water was freely used until the next day.

When I saw my patient again, he was entirely free from pain: the bleeding which succeeded the operation had removed the inflammation of the gums, and he felt so perfectly well, that I did not hesitate to comply with his request, to proceed on the next day with the operation, as he was anxious to return to Baltimore. Conformably to this design, I removed the tartar carefully from his teeth, and on the subsequent day, he left the city to return to his home.

I was afterwards informed that he was in good health, but I did not see him again for some considerable time. The disease was entirely arrested, his teeth had grown firm, and the gums were free from all inflammation. From the absorption going on in the alveolar processes of the extracted teeth, however, he had not been able to keep them perfectly free from tartar; and the second operation of scaling his teeth became necessary, which took place about one year after the first occurred.

His teeth were perfectly clean, and the gums and alveoli quite healthy in the month of September, 1819; when one of them was plugged with gold, and the carious parts of the incisores cut and filed out. I provided him with tooth powder, and requested him to observe rigid exactness with regard to cleanliness. Since that time I have repeatedly heard from him, and without the least complaint.

VIII.—*On the Tincture of the Poppy, made from the Entire Plant, as a Substitute for Laudanum.*—By DANIEL WILSON, M.D.*

IN reading the interesting remarks of Dr. Duncan, sen. of Edinburgh, on the preparation and use of the tincture of lettuce, I was led to suppose that a tincture of the

* From the Philadelphia Journal of the Medical and Physical Sciences, No. 4. for August, 1821.

papaver somniferum would prove a substitute for the tinctura opii, as well as for the celebrated gum from which that tincture is made. This idea presented itself on first reading Dr. Duncan's remarks about eighteen months since; and last summer I availed myself of an opportunity to subject my hypothesis to the test of experiment. Except the radix, I used every part of the plant, a quantity of which was obtained at the proper age for procuring the extract. In the eagerness of my pursuit, I dried the first parcel in the sun, but I was at once convinced that this would diappoint my views. A second parcel was procured and carefully dried in the shade; and having reduced it to a coarse powder, I proceeded with the intention of making a saturated tincture: the following is the result of my experiments.

℞ Pulv. pav. somnif. ℥ iv.
sp. communis ℥ xvj.
Mix, digest for eight days, and filter.

From these quantities I obtained eight or ten ounces of the tincture, which I forthwith introduced into my practice. Under the same principles which govern me in administering the tinctura opii, I gave the tinctura papaver: and in doses of double the quantity which I give of the former, I find the latter an effectual anodyne.

I am about trying a tincture made with the sp. vini, but my experiments are yet only in embryo. From tinct. pav. ℥ i. as above prepared, I procured extr. gr. xviij., but when formed into pills, they run together, unless given immediately, and are therefore fit only for extemporaneous use. I have laid aside the tinctura opii for some months past in my practice, not because I think it inferior to the tinc. papav., but because I believe the latter to be quite its equal as an anoydne, and, when considered in an economical point of view, its advantages are too obvious to require enumeration.

Professional pursuits, together with an unfortunate habit of procrastination, have prevented me from making this communication sooner. I hoped, too, that more time would

have enabled me to make it more worthy of the attention of the faculty; but as it is now uncertain whether I shall be able for some months to add to, or diversify, my experiments, I have resolved, imperfect as it is, to commit my project to the hands of others.

Louisville, June 18th.

IX.—*On Consuming the Smoke produced from the Furnaces of Steam Engine Boilers, Brewers' Coppers, Sugar Refiners' Pans, &c.* By the EDITOR.

WITH A PLATE.

In plate III. fig. 1 and 2, we have shewn the introduction of one of the late Mr. Sheffield's *Patent Air-Conductors* to the bridge of one of his most improved reverberatory furnaces; by which important addition, he obtained the power of admitting or excluding the atmospheric air in its purest state at pleasure, and thereby obtained the means of either calcining or reducing the ores, &c. operated upon in the furnace, as the circumstances required. It also constantly had the desired effect, on the air being admitted, of consuming the smoke produced from the coals, and converting it into flame.

When, therefore, the consuming of the smoke produced from the furnaces of steam-engine boilers, &c. became a desirable object, the application of this air-conductor to that purpose naturally occurred; and accordingly Mr. John Wakefield, of Manchester, took out a patent, subsequently to Mr. Sheffield's, for the consumption of the smoke produced from the furnaces of steam-engine and other boilers; and in which patent he claims the invention of this air-conductor, and also its application in the bridges and side-walls of such furnaces. Now it is evident, that, at most, he could only claim the application of Mr. Sheffield's prior invention to this particular object; and, even then, could not employ it during the remaining term in his patent, without Mr. Sheffield's licence. And

in regard to the invention itself, he had only to visit the brass and copper works in Staffordshire, the adjoining county to Lancashire, belonging to the Cheadle Company, and he would have seen it constantly in use, under a patent licence from Mr. Sheffield.

Mr. William Johnson, a brewer at Salford, near Manchester, has also since taken out a patent for the same object, and lately published his method of carrying it into effect; and fig. 1, in plate IV. is a representation thereof. In this figure, the reader will, on comparing it with fig. 1, plate III. instantly see the exact counterpart of Mr. Sheffield's patent air-conductor for furnaces, as applied by Mr. Johnson, in the bridge of the furnace of a steam-engine boiler; and accordingly we shall describe it nearly in the terms of Mr. Sheffield's specification, as follows, viz. —The letter *a* represents the tube or leading part of the *air-conductor*, and *b* the aperture or mouth of the same; *d*, the flues leading to the chimney; *e*, the ash-hole, and fire-place; and *i*, the register, with its handle, *k*.

It may be observed, also, that *g h* denote the bridge of the furnace containing the air-conductor: *á* represents the steam-engine boiler; *é*, the iron door for occasionally cleaning the flues; and *f*, a stop-wall.

In his publication, Mr. Johnson says, that some difficulty was experienced at first, through the great wear upon the upper part of the *after-bridge;* but, by getting it made in two pieces of fire-brick, it now stands very well.

Our readers may possibly require an explanation of the term *after-bridge*; no such thing appearing in Mr. Johnson's representation of the furnace. To elucidate this, we annex the second figure in plate IV. which is nearly copied from the specification of his patent; and in which it will be seen that he introduces a current of cold air into the furnace, from the ash-pit, *c*, through the register, *i*, and between the bridge of the furnace, *g*, and what he terms an *after-bridge*, *h*; and the inevitable effect of of which must be, that this current of cold air, striking

directly the bottom of the boiler, must cool it, and cause a demand for an additional quantity of fuel to remedy that evil. In order, therefore, to avoid this serious inconvenience, he has, since taking out his patent, added Mr. Sheffield's *horizontal* part of his air-conductor to the *vertical* part he had before employed; and thus converted his bridge and *after-bridge* into a bridge, containing Mr. Sheffield's air-conductor within it, and exactly what is described in the specification of Mr. Sheffield's patent.

The furnaces of a steam-engine boiler, of many sugar-refiners' pans, and of several brewers' coppers, in the metropolis, have been altered upon this plan, and with the most complete success. We have therefore to congratulate the public on the probability that the annoying nuisance of smoke produced from the furnaces of steam-engine and other boilers, will, shortly, in a great measure be abated.

X.—*Method of Ventilating Coal Mines, by Mr.* James Ryan, *Director of Coal Mines (late of the Netherton Colliery, near Dudley); for which he received the Gold Medal and* 100 *Guineas from the Society for the Encouragement of Arts, Manufactures, and Commerce, Adelphi.—In a Letter to the Secretary,* Dr. C. Taylor*.

WITH TWO PLATES.

Sir,

The numerous and melancholy accidents which have happened in the Coal Mines of Great Britain for a long period, and particularly within the last few years, have at-

* From Vol. XXXIV. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The tremendous explosion of hydrogen gas in a coal pit at Carville Colliery, near Newcastle-upon-Tyne, in October last, which occasioned the death of fifty-three of the best workmen employed in that colliery, and left no less than twenty-six widows and ninety fatherless children dependent upon charity for their support; added to the very frequent accidents of the same destructive nature which are continually occurring; evidently point out *the total insufficiency of the system of ventilation employed there*, and loudly call for the introduction of a more effectual plan, by which this shameful waste of human life may be, in a great degree,

tracted the attention of the humane and scientific part of the community to the subject of discovering a better system of ventilation than that hitherto adopted.

Accustomed as I was by my profession to these distressing scenes, humanity soon prompted me to exercise whatever ability practice and experience had given me, in devising a method to prevent the repetition of accidents so baneful in their effects.

Having brought my plans to a degree of practical perfection, I beg leave to lay before the Society, for its approbation, an entire new system of Ventilating Coal Mines, founded upon the results of thirteen years' intense application, and nine years' actual and severe experience.

Previously to laying before the Society the detail of my system of ventilation, it will be necessary to describe the method adopted hitherto.

In the annexed drawing, Plate V.* the Society will perceive the ground plan of a Colliery, on the most approved system hitherto known, and as wrought by the most experienced mine engineers or colliery viewers of the north of England.

From this drawing it appears that the ordinary way of working the thin coal seams is in parallel passages, called *boards*, about four yards wide and eight yards asunder; which eight yards comprise a solid mass of coal, supposed to be necessary for the support of the roof, although, in fact, much less would answer this purpose. These *boards* are connected at the distance of every twenty yards by smaller passages, called *headways*, running at right angles: the pillars which support the roof are thus about twenty yards by eight in dimension.

The headways are driven in straight lines through the

if not totally, prevented. And the Editor believes he is rendering an essential service to the cause of humanity, by endeavouring to give currency to the above interesting Article.

* Taken from the Letter of Mr. John Buddle, introduced into the First Report of the Society for preventing Accidents in Coal Mines. Printed by Edward Walker, Newcastle, 1814.

whole extent of the mine, and are made for the purpose of communication between the boards, in which nearly all the coal intended for sale is raised.

Into each mine two or more *shafts*, or pits, (or one pit *bratticed*, or boarded off, so as to serve the purposes of two,) are sunk, by which the coal and water accumulating in the workings are raised. One of these shafts, A, in reference to its use is called the *downcast shaft*, and the other, B, the *upcast shaft*, by means of which, in addition to its other uses, the gas is carried off. The distance between the two is in general from half to two-thirds, or nearly the whole length of the workings *.

The system of Ventilating Collieries hitherto employed, consists in forming all the boards and headways, or, in other words, passages of a mine, into one immense labyrinth, connected at one end with the downcast, and at the other end with the upcast shaft; this arrangement is effected by fixing up *stoppings*, consisting of brick, or stone and mortar, or strong boards called *brattices*, in such situations as to intercept the current of air in every direction, but that in which it is necessary it should traverse, in order to sweep, as it were, in its course every avenue and corner of the mine. The current of air, which enters the downcast shaft, has thus to travel 27 miles in an area of 600 yards square; a distance which it will readily be supposed requires a considerable power to force an effective current through its whole extent: in fact, it seldom happens that the velocity of this current exceeds two miles per hour.

In the First Report of a Society established at Sunderland for preventing accidents in Coal Mines, printed in 1814, the following passage occurs, at p. 5: "The only "method we are at present acquainted with for preventing "accidents by fire, is a mechanical application of the at-

* The double lines shew the air-stoppings or doors, erected for the purpose of preventing the air from passing into any working, when not necessary. The single lines shew the brattices; and the darts and dotted lines, the course of the current of air passing from the downcast shaft through the mine to the upcast shaft, where it ascends.

" mospheric air to the removing or sweeping away of the " inflammable gas, as it is generated in the workings of " collieries, or as it issues from the several fissures which " the workings intersect in their progress."

This mechanical application of atmospheric air is produced, according to the above Report, in several ways; but all of them have been found either inefficient or dangerous.

Amongst these ineffectual contrivances may be reckoned, 1st, The blowing engines for propelling air down the shafts; for the greater part of their power is expended in sending a stream of air through this enormous extent of passage; which stream of air neither operates perfectly in the higher lodgments of the mine, nor in the breaks where gas accumulates.—2d, Falls of water, carrying with them a current of air; these render one of the shafts useless for every other purpose, and increase the labour and expenses of clearing the mine of water.—3d, The air-pumps, which, besides being inefficient to propel a full stream of air from shaft to shaft, deprives the miners of the use of the upcast shafts while it is at work.

Among the dangerous expedients now in use, it is only necessary to mention the *furnace,* placed near the bottom of the upcast pit, which is supposed to produce the requisite current by the rarefaction of the air within it. Over this furnace all the air of the mine (including, of course, all the hydrogen gas mixed in various proportions with atmospheric air) is compelled to pass.

It is suggested in the Report before mentioned, that the furnace should be extinguished the instant an overpowering discharge of inflammable gas takes place in any part of the mine; but the inflammable air may reach the furnace before any previous intelligence of its approach can be given at the bottom of the shafts, in time to enable the workmen to extinguish a *chaldron or upwards of burning coals!*

To elucidate still further the present mode of ventilation, (for I consider it essential to bring the two systems in comparison,) it may be necessary to state that every coal mine or

working is confined to the depth of one stratum, or, in cases where the strata are thin, of two or more, so as not to exceed eight feet in general depth from the roof to the floor of the mine. The roof, and the floor, (or *thill*, as it is called,) although they are nearly equidistant, are never perfectly horizontal, but incline, or *dip*, from that position in different angles. From this last circumstance, it is evident that one board will perform a *descending* course, whilst the next *ascends*; thus alternately changing its direction at every turn, and generally leaving a gradually accumulating portion of hydrogen gas at the commencement of every descent, probably mixed with or diluted by atmospheric air, but thus rendered more and more susceptible of explosion on the approach of flame. In Felling Colliery, for instance, the hydrogen gas is supposed to descend in its serpentine course not less than two hundred and fifty feet, perpendicular height, in *each* revolution of the air through the boards and headways. Now, when we recollect that hydrogen gas is so much lighter than common air as to float upon the latter as oil does upon water, it is evident that the hydrogen gas will accumulate in the higher part of every turn or winding of its course, precisely in the same way as the air which lodges in the upper part of a bent water-pipe contracts the passage for the water, and finally stops the current unless propelled with great force.

A similar phenomenon takes place in the coal mines. The hydrogen gas lodges in the upper chambers or crevices until the current of air increasing, and requiring more room, forces the gas into motion, and thus in a state of dangerous mixture or dilution, the two fluids traverse the rest of the workings seeking the flame, which is to arm them with destruction. And here it must be remembered that the miners' *low*, or candle, is equally enabled to communicate explosion as the greatest flame possible: it is believed that all the explosions at Felling Colliery took place in this way, at the upper levels of the mine.

This method of ventilation has frequently been success-

ful when performed in all its detail with accuracy and skill, and under the favourable circumstance of being used in thin coal seams, containing but little hydrogen.

Some of the Staffordshire colliers were able in this way to clear their six or eight feet seams with a comparatively small loss of life: at last they diluted the inflammable gas to such an extent with atmospheric air, as to produce an unexplosive, and of course a harmless, mixture in general; so that this system may not improperly be called the *Diluting System of Ventilation.*

It now remains to describe the method of clearing mines of foul air, by means of what is called the *firing line*, or which, for the sake of distinction, I shall denominate the *firing process.*

This dangerous operation is performed by an apparatus consisting of a long pole, or a series of poles fitting one into the other like a fishing-rod, so as to be elevated to the break, or *pot hole*, where fire-damp is accumulated: at the upper end of this pole, a copper wire is passed through upon a small sheave or wheel, which wire is made to reach to any distance within the area of the mine from the horse stable: this done, the pole is firmly fixed in the place where the gas lodges; the candle, fixed to a piece of lead or other substance to keep it steady, is carried by the fireman as far towards the explosive region as safety will admit of, when it is set upon the floor, and fastened to one extremity of the copper wire;—this done, the firemen retire to the stable, which is made strong, and well secured, in order to barricade them; the other extremity of the wire is passed through a crevice in the door, by which means they draw the wire until the light gets to its destination:—in some instances they remain pent up for a length of time, in the greatest suspense, owing to some accidental circumstance having put the candle out, before it reaches the *pot hole;* when they are fearful of venturing out, from the uncertainty of what may be the event.

In many instances it has been found necessary to explode

these lodgments three times a-day, at each time clearing the mines of all the workmen, except the firemen; the necessity of which has been occasioned by the miners cutting down strata or measures of coal, so as to render their roof higher than the general run of six or eight feet seams, and by this means making the extra elevation too great to be affected by the diluting current. In short, when the roof of a coal mine, where the seam is thirty-six feet thick, is cut down, no means but the *firing process* could hitherto suspend, even for a day, the destructive effects produced by an explosion affecting the whole mine.

The expense of this process, besides the loss of many of the firemen, was immense:—it was necessary to leave an unusual substance of coal in the pillars to support the roof against the shocks; the body of coal itself was besides damaged both by the concussion and by the heat attendant upon the combustion of the gas; a heat which frequently set fire to the seam of coal, and required the stoppage of the shafts for its extinction.

Lord Dudley and Ward, greatly to his honour, employed the most eminent coal viewers from Durham and Northumberland, to devise some expedient by which this calamity might be averted, but in vain:—with all their skill and ability, not a single explosion was prevented.

It is in such mines as these, that my system of ventilation has been brought into use to the fullest extent, and with the happiest results.

Having thus described the methods of ventilation now in use, I shall proceed to lay before the Society an outline of the plan which I have successfully pursued for several years, as testified by the certificates herewith transmitted, and to which I request the particular attention of the Society.

The annexed drawing (plate VI.) exhibits the ground plan of a coal mine ventilated according to my system, and worked so as to yield a much greater quantity of coal from any given area at an expense in no case equal to one-third of the former method.

The *white line* round the square exhibits the gas headway, enclosing a given area, and communicating with the upcast shaft at B.

A, the downcast—B, the upcast shaft.

C represents a collateral gas headway, made to carry off the gas, when a dyke, having thrown down the strata in any part of a seam, renders the elevated or upcast side higher than the general level of the main gas-course, in which case this is carried to it.

The black squares represent the pillars left to support the roof: by comparing those left in the line from shaft to shaft, the pillars *d* and *e* will shew the stronger supports left under any building.

F, a fall of stone or shale from the roof, which merely knocks down a few pillars, without obstructing the ventilation.

G, part of a coal seam unwrought, with a working round it, interrupted by a fall of the roof at N, which merely stops up one holing or aperture into the gas headway, whilst the foul air passes through the next apertures, as represented by the darts *h*, *h*.

The cross darts, *i*, *i*, *i*, *i*, shew the holings at the lower part of the mine, made into the bottom of the gas headway; and through which the carbonic acid gas escapes upon the water level.

K, a tube, made to carry off the gas from the upper levels of a mine when not supplied with *holings* into the gas-course, in the line of its rise, as at *e*, *e*, *e*: this mode admits horses to draw under it, which, by the system heretofore used, is performed by brattices or partitions, as at M: but it is seldom necessary in my plan to make use of this tube.

The darts shew the manner in which the gas creeps off into the gas headway*.

* Two other plates, shewing sections of the strata, are omitted, as they do not materially conduce to the explanation of this method of ventilation.—EDITOR.

In working the gas headway through the higher parts of a mine, the under strata are bored every twenty or thirty yards a few feet through, in order to draw off the gas from the lower strata. When an open or porous incumbent stratum lies near, the gas may sometimes be let off by boring into it.

If the old system of ventilation were to be abandoned, the pillars left to support the roof might be re-worked to a considerable extent: in my system, pillars will be left without any regard to, or necessity for, regularity, so as to afford sufficient support to the roof, and to every locality which may occur to make precaution necessary; by which means much more coal will be obtained from a given area.

Although it may be only necessary to cut a very few yards from the pit or shaft to get on the highest line in the coal field, to effect the mere purpose of ventilation from hydrogen gas; yet it is important to have a thorough knowledge of the stratification to enable any one to carry on my future operations with advantage. In the working of coal, an excavation, or gas course, should be driven sometimes entirely round the works, for the inflammable and vitiated air to pass off, which, being lighter than common air, will go off by the higher level. The carbonic acid gas will, from its gravity, seek the water level, or the lowest parts of a mine, as shewn at *i*, *i*, *i*, *i*, in plate VI.

The dimensions of the holings or apertures into the above gas-course, must be judged of from the quantity and relative specific gravity of the gases which they are intended to receive.

The surrounding of coal fields by headways is generally practised by every intelligent director; as the risk run without such a precaution is very great, and many lives have been lost, and works shut up, from an ignorance of the stratification, a knowledge of which would have been acquired by driving the headway. This course also secures the miners against all sudden irruptions into old wastes, which might, and frequently do, let in water, accumulations of

gas, &c. upon the men. In cutting it, the different dislocations met with should be noted down, with their angles, bearings, &c. and transferred to the map made to govern the general arrangement of the works as the colliers advance. A director, who has his field once surrounded, is enabled to examine every part geologically, and can proceed without fear of danger from any quarter: and, as he requires a greater extension of his field, he has only to drive a line off from this common gas passage to still higher parts, should they occur.

The gas-course should be attached to the drawing, or upcast shaft, by two folding doors, one of which should be made to close before the other opens: by such an arrangement, coal can be safely drawn up at the upcast shaft, as the trap or folding doors will prevent the common air from communicating with it: the gas-head should be made to discharge itself a few feet, say ten or twelve, up the shaft, so as to prevent the possibility of flame approaching the gas on its entering the bottom of the pit; with this precaution, lights may be kept, in some lower point, on the opposite side of the shaft to that which the gas enters.

The holings, or small gas-courses, made in the main gas head-way, must necessarily accompany the works as they advance; or, in fact, it is better to have them made as far forward as possible: the *holings* into the gas-course from the board, or headway adjoining it, may be made with a boring-rod of three inches in diameter, or, if necessary, of a greater diameter; which will be sufficient to carry off the hydrogen gas generated in their neighhourhood: but the principal passage for the gas must be at the very highest part of the workings, into which hydrogen gas, azotic gas, and, finally, cold air, will flow in succession; but the backs and slips should be mostly depended on to effect ventilation.

It is supposed that by the old system a standard current of air moves through an aperture of thirty feet area, at the rate of three feet per second, which equals 5400 cubic feet per minute; and that this is capable of diluting about

twenty-eight and a half feet of gas per second, or one thousand seven hundred and ten feet per minute, so as to render it perfectly harmless: this, however, only gives three parts of air to one of gas, which, supposing the equality of this proportion, must render it an explosive mixture. But this dilution *is not* regular, nor does the gas distribute itself equally; for in some parts the hydrogen remains nearly pure, and, in others, diluted beyond the explosive point; but in the higher parts of a mine, a great collection may always be expected, mixed up to various points of explosion, and more particularly at the last of the air, as the accumulations of every other part of the mine must pass through it.

By a gas-head of the same capacity, in my system, I can, according to the above rate of three feet per second, bring off ninety feet of gas in that time; but if the gas be pure, its travel or rate of going will be in proportion to its levity and the rarefaction in the gas headway. I reckon, therefore, upon the rate of at least ten feet per second, which would carry off 300 feet of gas each second, or eighteen thousand feet per minute: but this generation is far more than can be presumed upon in any mine; so that the extremity of security, afforded by my system, would probably never be put to the test: the distance of its course in a coal-field of nine hundred yards, will seldom exceed twelve hundred yards. A part of the old works being left with good stopping, will answer the purpose, with little alteration, of gas headways in my system. But if the gas-course is to be cut off in the solid coal, an excavation may accompany it, as described round the upper part of the ground plan, plate VI., as a board to get coal from; this will take off the gas as it is extricated, and will prove a common passage for the air, which has full liberty to flow through the mine; but on its departure up the shaft will be preceded by the lighter fluids, into the gas-course.

To elucidate my system still further, I will introduce the following analogy:—If a large thin book be placed in a

slanting position on a bed of clay or stone, and covered with another bed or stratum equally impervious to gas, it may represent a seam of coal, which is separated into laminæ, correspondent to the leaves of paper. This is precisely the case in those mines where the seam of coal runs out to the surface, uninterrupted by faults: in such mines explosions are never known.

But when the seam is separated by a fault, which, to pursue our illustration, may be imitated by cutting the book in two, with its supporting and superincumbent strata of clay; raising or depressing one portion, until the leaves of the book no longer touching each other, rest against the clay; and *vice versâ:* such a fault it is evident will no longer permit the free transmission of the noxious gas into the atmosphere, from the portion of leaves situated below the fault; whilst that part which still presents its higher edge to the surface continues as safe as before: in this case I bore a sufficient quantity of holes from the seam below the fault, or downcast, to the seam above it, or upcast, in order to let the gas pursue its course.

[*To be continued.*]

XI.—*On Melting Caoutchouc, or India-Rubber, and Preserving Iron and Steel from Rust. By* ARTHUR AIKIN, *Esq. Secretary to the Society for the Encouragement of Arts, Manufactures, and Commerce.—In a Letter to the* EDITOR.

19, John Street, Adelphi,
December 24, 1821.

DEAR SIR,

You well know the many attempts that have been made to preserve iron and steel from rust, and the small success with which they have been in general attended. Greasy and oily, or resinous, substances have formed the basis of the different preparations proposed and employed for this purpose: but in the former, when rancidity comes on, an

command for furnishing light, filling balloons, or other purposes. If water be composed of 85 parts of oxygen and 15 of hydrogen *; and carbonic acid gas, of about 28 of carbon in the 100; one pound of charcoal, and not far from four of water, ought to give something like two hundred and fifty gallons of carbonic acid gas, or enough to supply that quantity of as nearly strongly impregnated mineral water as is to be found in nature †; and near five hundred gallons, or about seventy-five cubic feet of hydrogen gas, something like equal to twenty-five pounds, or six wax candles burning twenty-five hours, for affording light. Some very trifling addition of spirit of turpentine, or other substance, will be required to make the flame white. These gases, as formed, may be forced into the aqueduct of a limited quantity of water, to be conveyed along with it to some desirable situation to be let out for use. The quantity of water let in will depend on the quantity of mineral water wanted. If a flame be applied to the surface of these fountains, the hydrogen gas takes fire and burns on the surface of the water; thereby, perhaps, exposing some of nature's hidden operations.

In this way, towns, cities, and manufactories, may be, for ought that yet appears, supplied with a pleasant, healthy drink, and at the same time, and from the same materials, abundantly lighted. There must be an addition of some kinds of fuel, to preserve the red heat of the charcoal, and to evaporate the water. But that will be trifling; especially if it be a fact, as I fully believe, that carbonic acid gas, in forming, always gives out, instead of absorbing, heat. If so, it is at least one source of animal heat. As yet, my attention, so far as my health would permit, has been directed chiefly with a view to come at an easy mode of furnishing mineral springs, by the disengagement

* The most recent authorities give the composition at 88.24, of oxigen, and 11.76 of hydrogen.—*American Editor.*

† Carbonic acid Gas derived *directly* from almost any species of *burning* fuel, would be very prone to impart an empyreumatic taste and smell to the water in which it is condensed.—*American Editor.*

of the carbonic acid from marble, by the stronger acids. For that purpose, and others, I had a small cool spring of water brought in a wooden aqueduct about one hundred and fifty yards, having a descent of fifty feet, all the way on an inclined plane; so that the water should, in no instance, fill the bore of the logs, and obstruct the passage of the gas or gases, if turned into the aqueduct with the water, or forced in at the bottom.

I found no difficulty in filling the aqueduct with water, so as to give a pressure or head equal to thirty or forty feet perpendicular. Very fine streams of water, issuing under any thing like this head, and coming in contact at nearly a right angle, with a plane surface, were converted into a spray, as fine, much of it, as mist. When this mist or spray was forced into an atmosphere of pretty strongly compressed carbonic acid gas, it became suitably impregnated with the gas, so as to form a very pleasant drink. To facilitate the impregnation, and to prevent a possibility of any of the sulphuric acid being retained by the water, and for other purposes, I filled the vessel (a common three gallon stone jug answers well) about two thirds or three-fourths with grains of the marble, about the size of large peas: the spray falling on these, passing slowly from one piece to another, gives more time, and presents an immense surface to the gas. In this way, water under a pressure of twenty or thirty feet head, or much less, issuing at the rate of about two half-pint tumblers per minute, flows in, pure spring water at the top, and flows out nearly or perfectly saturated at the bottom: as much so, nearly, as any known natural spring. By adding one vessel to the top of another, or increasing the length, and increasing the pressure, any desired quantity of the gas may be added to the water. Indeed, any part, or the whole length, of the aqueduct, may be filled with these fragments, and with those of iron. The gas and water evidently dissolve more or less of the lime and iron. Carbonate of soda, or any other substance which renders the water more healthy or useful,

may be added in any desired quantity. The quantity of water that flows in, may be regulated or stopped, so as to meet, very exactly, the call or demand there shall be for the mineral water. The overplus of the spring water is applied to keep the vessels and mineral water cool. This mineral water, with a portion of the gas, may be continued into an aqueduct, and discharged into the bottom of a box, in which they will rise up for use, with the same bubbling appearance as those of the natural mineral waters. Some of the marble, which I use, appears to contain much sulphuretted hydrogen*, and some iron pyrites. If the mineralized water stands a day or two on these fragments of lime, it gives the water as strong a smell and taste of this gas, probably, as any natural spring in the world; and there is an appearance of iron being deposited from this water by standing in a glass vessel. How easy then to produce at one establishment, from a single spring of pure water, our choice of any number of mineral waters, and those as good as any to be found in nature, or possibly better!

If the vinous fermentation should be adopted for procuring the carbonic gas, a flood of it may be procured from many sources, not only without expense, but even at a profit.

But, in those situations where these waters will be most wanted, and where they are much the most useful, I know of no reason why an abundant supply of the gas, ready formed, may not always be had, and that without expense—I allude to breweries. At as many of these as is necessary, (where there is steam or other power,) it will be but to avail ourselves of a forcing pump to drive the gas, as formed and purified, or from reservoirs, into suitable pipes, with a

* It is doubtless *one of those felid, although crystaline and decidedly primitive, lime stones*, which have been found repeatedly of late in this country; their existence must give rise to interesting geological speculations. Is the sulphuretted hydrogen, from which fetor is probably derived, owing to the decomposition of pyrites by moisture? Pyrites often exist in primitive rocks, but animal bones never.—*American Editor.*

sufficient quantity of water, to be conducted to some pleasant, suitable situation, far enough to have the water properly impregnated, and then to be let out for use. If a greater pressure than what the ground naturally affords be wanted, it is only to add, at the outlet, a valve sufficiently loaded. A small fountain may receive the water and overplus gas, above the valve, or they may be drawn below.

It appears necessary, that, where the gas is disengaged from limestone, the vessel containing that, and the diluted acid, should in some way be agitated, so as to shift the position of the pulverized marble. The best mode I have tried, as yet, is to cause the vessel to revolve, say a stone jug, on an axis, and end over end: and to have a portion of the marble coarse. As the sulphate of lime forms on the surface of these lumps, by their friction in rolling over each other, it appears to be worn off, presenting continually fresh surface for the acid to act upon, and thereby continuing very regularly its operation, ever so long. These vessels may be made to revolve (very slowly if necessary) by weights, springs, or a parapet of the water, or may, occasionally, be moved by hand. The gas presses out at one end of this axis. A very cheap, quick, and agreeable mode of preparing the water, where we have (or have not) an aqueduct, or head, to resort to, is to take four or five, or more, decanters, say of the capacity of a quart; fill them with fragments of marble—set them in a row or other form, each with a good cork; let a tin tube screw upon the axis to receive the gas, and press pieces of cork, or other stuffing, to the vessel, to make it tight round the axis. This tube, near the other end, is of a conical form, and turned down at a right angle, far enough to be inserted through the cork of the first bottle: another tube, turned down at each end, so that one leg shall pass through the cork also, to the bottom of the first decanter, and the other through the cork of the second decanter; and so on with as many as are to be used. A small reservoir is to be placed as many feet above as con-

venient, and the first vessel, with a small pipe leading down and through the first cork, with an opening at the lower end, about one-thirtieth of an inch in diameter. A quantity of pulverized lime and water may be put into the revolving vessel; then more water, containing a small quantity of clay or sulphate of lime. This will be deposited on the lime, so as to prevent the action of the acid when poured in, which may now be added, and this vessel corked. It is now ready for use.

Put cool water into the reservoir, turn the vessel, moderately, a very little, if the gas is not already forming fast enough. The water strikes on the first fragments of stone, is thrown over them, and passes over the surface, from one to another, to the bottom, where it is continually taken up by the tube, with a portion of the gas, and discharged just below the cork of the second vessel: or thrown out, in a spray, by and with the gas; or else discharged at the lower end of the tube in bubbles; thereby furnishing a carbonic gas within and without, with an almost infinitely thin film of water between, to absorb it on each side. By continuing the same process, it passes the whole, let the number be ever so many. At the last one it is thrown out, through a stop-cock, as at common soda-water establishments, or flows out in a continued stream with the gas. It may be well to fill the first decanter, or even all of them, with water, and discharge it into the last one, by the gas, before the water is let in from the reservoir above. These glass vessels may be placed in a trough to keep them cold: this can stand on a table or side-board, where the domestics, or other members of the family, may, at any time, furnish a bottle or bottles of the mineral water when wanted.

If tin plate tubes will answer, it is but a short day's work to prepare this apparatus; which may afford sixty or one hundred and twenty tumblers per hour, with half a dozen decanters. By increasing their number or size, any given quantity in this way can be constantly or occasionally supplied. One pound of sulphuric acid, if I mistake not,

ought to furnish gas enough to saturate sixty or seventy gallons, or not far from one thousand tumblers of water. Experiments, I think, justify me in saying, we may expect not far from half this quantity, *practically*. I can but hope, and do believe, if owned and properly managed by corporations and companies, it may and will do much, very much, towards annihilating the use of ardent spirits, as well as be the means of saving many annually from an untimely death by drinking cold water, to say nothing of its usefulness in other respects.

When currents of this gas, conveniently situated, are found issuing naturally from the earth, they may be turned to account. As, for instance, at the Grotto del Cane, two miles from Naples; if the gas from this grotto were received into an aqueduct, and carried in the direction of Naples, or in any other, until a supply of water could be added, the current might be continued until the gas and water were perfectly united; and then they might be let out for use in any situation most agreeable, or most conducive to the comfort and convenience of that city or country.

Orford, September 27, 1820.

Postscript.

From an ounce of sulphuric acid, I practically obtain (I may say without trouble) about twenty tumblers of as pleasant drink as I could wish for.

It is a great luxury; and I have no doubt that it has been of much service to my health. The sulphate of lime, here, is worth six or eight times what the ground marble costs.

XIII.—*On American Lime for Water Cement**.

THE following notice of the lime used in the sub-aqueous constructions of the great canal in the state of New York, is contained in a letter from Benjamin Wright, Esq. chief engineer of the Erie Canal; dated Rome, June 24, 1821.

* From Vol. III. of Silliman's American Journal of Science and Arts.

DEAR SIR,

The specimen of argillo-ferruginous limestone, herewith presented, is found in great abundance in the counties of Madison, Onondaga, and Cayuga, in the state of New York. When found *in place*, it is always under the blue lime, which is uniformly overlaid with grey lime. The grey is the upper stratum, and is found in large heavy blocks; the whole six or eight feet in thickness. The blue, which next occurs, is various in thickness; and from it is made the beautiful white lime. Under the blue lies the first described, which is found to be a superior water cement, and is used very successfully in the stone work of the Erie Canal, and believed to be equal to any of the kind found in any other country. I cannot give you the analysis—if convenient to give a sample to Mr. Silliman, for his examination, it might be useful to the community to have its properties fully understood; and if he thinks it merits a place in his useful publication, I presume he will give it. I do not know that it is found in the counties west of Cayuga, but presume, from the geological character of that country, it may be found in all the country west to Niagara, and, probably, further west. It is pulverized, (as it will not slack,) and then used, by mixing two parts lime, and one part sand. It hardens best under water; and it is believed its properties are partially lost, if permitted to dry suddenly, or if not used soon after mixing.

Mr. Canvass White, a friend of mine, has obtained a patent for it when used for *hydraulic purposes:* and, it is believed, it will answer an excellent purpose for rough casting, &c. For cisterns it will be much used, no doubt; and for all the principal erections of stone work for canals, it is indispensable.

Respectfully, I am,
Dear Sir, your obedient servant,
BENJAMIN WRIGHT.

To W. W. Woolsey, Esq.
of New York, U. S.

We are informed by Mr. Woolsey that the price of this lime, pulverized and burnt, and delivered at Utica, is twenty cents the bushel. Mr. W. remarks, that "Mr. Wright is a gentleman, equally distinguished for respectability of character and high attainments as a civil engineer, and that his accuracy may be relied on."

Postscript, April 3, 1821.

In February we had an interview with Mr. White, from whom we obtained the following result of the analysis of the hydraulic lime, by Dr. Hadley.

Carbonic acid	35,05
Lime	25,
Silex	15,05
Alumine	16,05
Water	5,03
Oxid of iron	2,02
	98,20

To this Notice we add the following Extract of a Letter from Myron Holley, Esq. one of the Commissioners of the Great Canal, dated Albany, 20th January, 1821.

Mr. White, one of our engineers on the Erie Canal, and a man of good character and useful attainments, especially on subjects connected with his profession, discovered, in the course of the season before last, the material for making an excellent water-proof cement, existing in great abundance in the western district of this State. And we have made extensive and profitable use of his discovery, in the locks and other mason-work of the Erie Canal. It is, probably, superior to Parker's Roman cement in quality, and may be afforded at less than half the expense of that. It will, therefore, probably soon come into general use throughout our country, whenever such cement is required. Mr. White has some specimens of the stone which constitutes the principal material of his discovery, which he intends presenting to you.

XIV.—*The History and Treatment of Bony Tumours* *. By William Gibson, M.D.

In health, a balance exists, between the absorbent and exhalent vessels, which preserves each part of the animal frame within regular bounds. Deviations from this natural standard, in many instances, produce diseases, differing in situation, degree, and character, from the slightest perceptible change of organization, to the most unlimited extent of morbid structure. Hence two opposite classes of disease result—according as the laws which regulate the decomposition or increment of the body predominate. In one case, the constituent particles are removed, and diminution is the consequence; in the other, an undue proportion of matter accumulates; giving rise to general enlargement or to excessive deposition, in some individual texture. In this way every tumour must form. A tumour, whether formed of cellular membrane, skin, muscle, or bone, is a vascular organized mass; receiving a supply of homogeneous particles from the texture upon which it is reared, or with which it is assimilated. If this view be correct, we may perhaps conclude that such diseases, in their incipient state or original formation, do not differ in composition from the organ or part from which they are derived; but acquire specific characters, as they increase, from peculiarities of constitution or from local causes, the operations of which are not always easily explained. That diseased superstructures, or "new productions which made no part of the original composition of the body †," never exist, we cannot pretend to assert; but we are inclined to consider

* From the Philadelphia Journal of the Medical and Physical Sciences, No. 3. for 1821.

This Article is important, not only as containing much valuable practical information; but still more so, as it has afforded a hint, from which the Editor has perfected one of the most useful surgical instruments hitherto known, viz. *Machell's Annular Saw*, by rendering it *self-acting*. Its construction will be made known in a succeeding Number of this Work.

† See Abernethy's Surgical Works, Vol. ii.

such formations extremely rare. The immediate foundation of every tumour, is probably laid in a bed of coagulable lymph: this lymph is rendered vascular, increases in every direction in proportion to its supply, becomes smooth or irregular, soft or hard, fleshy or bony, parenchymatous or medullary, according to the original structure from which it is derived. How it is enabled to assume specific, vitiated, or malignant characters, cannot satisfactorily be explained, so long as our knowledge of the operations of nutrition and secretion are confined within narrow limits. But it is not our purpose, now, to speculate; at a future period, we propose to enter upon the pathology of bony tumours; at present, only to furnish their history and treatment—commencing with the subject of exostosis.

EXOSTOSIS.

Exostosis appears, generally, as a distinct tumour of a bone, is smooth on the surface, seldom painful, and may remain long without becoming very large. Occasionally, the whole surface of a bone is found ragged or scabrous; consisting of numerous plates laid over each other, and sometimes piled to a considerable height in thick irregular masses. Again—the disease appears in the form of tuberculated knobs or irregular excrescences, closely connected, or insulated. In a third variety, spinous processes or bony spires are eked out several inches, and terminate either in a sharp point or a knob. After careful examination of diseased bones in the splendid cabinet of the late Dr. Wistar, and of numerous specimens in my own collection, I have met with no other forms of exostosis, than those mentioned. I conclude, therefore, that the disease seldom appears in any other shape; and under this impression shall denominate each variety according to its external characters. The first I shall call *circumscribed* exostosis; the second, *lamellated* exostosis; the third, *tuberculated* exostosis; and the fourth, *spinous* exostosis.

Under the term exostosis, authors comprehend several

diseases, essentially different in symptoms, structure, and appearances. Thus we have the "*fungous exostosis,*" which, according to the account given of it by Sir Astley Cooper *, must be the osteo-sarcoma, or osteo-steatoma, complaints specific in their nature and structure very remote from exostosis. The same may be said of spina ventosa. The divisions made by the French writers, founded upon supposed causes of the disease, such as the scrophulous, darterous, syphilitic, scorbutic, and carcinomatous exostosis, are equally faulty, since they do not designate any variation of structure or form, but only imaginary shades of difference. Upon the whole, then, we are inclined to consider exostosis as a mere enlargement, from inordinate deposition of ossific matter, transcending the natural limits of a bone, in the shape of a spherical tumour, a plated covering, an irregular excrescence, or a pointed production; in each of which, however different the figure, the structure is the same.

The bones are all subject to exostosis;—sometimes the disease prevails universally. An instance is related by Mr. Abernethy "of a boy who was so excessively afflicted with an apparent predisposition to exostosis, or an exuberant deposition of bony matter, that a very trifling blow would occasion a bony swelling on any bone of his body. His ligamentum nuchæ was ossified, and prevented the motion of his neck; the margins of his axillæ were also ossified, so that he was, as it were, completely pinioned. Besides all this, the subject in question had numerous other exostoses on various parts of his body †." Saucerotte ‡ has detailed the history of a man thirty-five years of age, in whom all the bones, except the teeth, were increased to double their natural thickness, but remained of the ordinary length. The skull became so large as to pre-

* Cooper and Travers' Surgical Essays, Part 1st. p. 170.
† Cooper's Dictionary of Surgery, Vol. i. p. 288.
‡ Medical and Physical Journal, Vol. i. p. 491.

sent an hideous appearance, and the eyes were forced from the sockets. The ribs were approximated, and the sternum, clavicles, and scapulæ, uncommonly prominent. During the increase of the bones, the patient could not move himself, breathed with great difficulty, and suffered from pain in every part. The pulse was scarcely perceptible, and the urine deposited a thick white sediment. After suffering for seven years he died, but permission could not be obtained to examine the body. Such is sometimes the predisposition to exostosis, that even the muscles and tendons are completely ossified. A striking example of this kind is recorded by Dr. Henry *. The patient was a labourer nineteen years of age, and first perceived a painful swelling in his right wrist, which gradually increased, involving all the muscles of the fore-arm, and converting them into solid bone, as high as the elbow. The left arm was attacked in a similar manner; then the right leg from the ancle to the knee; and, finally, the disease extended from the shoulder to the fingers of each arm.

Of the individual bones, the cranium, lower jaw, ribs, sternum, and long bones of the extremities, are particularly liable to suffer from exostosis.

The frontal, parietal, and occipital bones are sometimes irregularly thickened by ossific depositions; at other times they are changed into regular plates of uncommon thickness. There is a skull in the possession of Dr. Davis, of this city, taken from a young negro, in which all these bones are upwards of an inch in thickness, and extremely compact and solid. Examples nearly similar are given by Sandifort †. The os frontis is more subject to exostosis than either the parietal or occipital bones. Frequently the external table is covered with bony excrescences, composed of spiculæ, resembling crystallizations ‡. Occasionally both tables are involved, and encroach upon the dura mater

* Philosophical Transactions, Vol. xxi. p. 89.
† Museum Anatomicum, Vol. ii. p. 13.
‡ Baillie's Engravings of Morbid Anatomy, p. 208.

and brain. Every variety of exostosis has been found on the skull; but the lamellated is the most common.

Exostosis may occupy the orbit, and become so large as to displace the eye. A few cases of the kind are recorded by writers. In the Edinburgh Medical and Surgical Journal*, an interesting history is furnished by Mr. Lucas, of a bony tumour an inch and a half in length, two inches five-eighths in circumference, and weighing an ounce and two drams; which grew from the orbit of a woman twenty-eight years old, and forced the eye forwards and outwards—causing it to hang beyond the exterior edge of the socket. The disease was produced by a blow from a cow's horn, on the upper and inner angle of the orbit, nearly on the transverse suture. Mr. Lucas divided the upper eyelid, and exposed the bone, which was so firmly fixed as to withstand every effort to extract it. The wound did not heal, and the bone continued to increase for some time. At length it became carious, and was finally drawn away, but not without difficulty. The eye was placed in its natural situation; and the sight, although nearly destroyed by pressure, was soon completely restored. Upon analysis, the tumour was found to consist of cartilage, phosphate of lime, and carbonate of lime; was extremely irregular; resembled a wedge cut out of a sphere, and so hard as to admit of being polished like ivory.—A very striking example of inordinate disposition of bony matter upon the orbits and adjacent parts, destructive of each eye, is recorded by Howship†. A man aged 50 took cold; inflammation supervened; and a tumour of the size of a hazel-nut formed below the inner angle of each eye. These continued to enlarge, and were attended with intolerable pain, and extended to the bones of the face and head. The eyes were constantly inflamed and pressed forward, in proportion as they were encroached upon, until they were displaced and burst. When examined by Mr. Howship in 1815, the patient, independent of loss of sight, and

* Vol. i. p. 405. † Practical Observations in Surgery, p. 26.

occasional head-ache, enjoyed good health. The tumours of the maxillary bones were as hard as ivory, and not in the least painful when pressed, filled the orbits, and inclosed the nasal bones so as to obliterate the nostrils.—A large exostosis of the consistence of ivory, and filling the left orbit, is represented in Dr. Baillie's plates of morbid anatomy.

The facial bones are frequently the seat of exostosis. "We have," says Sir A. Cooper, "in the collection of St. Thomas' Hospital, a skull which I took from a fish-woman who died in that hospital, who had long been remarkable (even at Billingsgate) for her hideous appearance. Two large swellings had been formed under the orbits in the forepart of her cheeks, between which the nose appeared wedged, and the nostrils were closed; each eye projected considerably from its socket. This person was seized with a fit, which seemed to be of an apoplectic nature, and in that state was brought to St. Thomas' Hospital, where she almost immediately died. Upon examination of the head, an exostosis was found growing from each antrum, and forming the large swellings upon the cheeks: these also projected into the orbit so as to occasion the protrusion of the eyes. On the left side the exostosis entered the cranium, projected inwards through the orbitar process of the os frontis, and occasioning such pressure upon the brain, as, under a considerable excitement of the vessels of that organ, to produce apoplexy, which proved fatal to her*." An exostosis sometimes arises from the cavity of the antrum maxillare. At other times the polypus, or fungus, which sprouts from the lining membrane of that sinus, is converted into a hard and incompressible exostosis. Mr. Abernethy† has furnished a very curious case of this description. The patient suffered more than nine years with a fungus, which bled profusely, but finally sloughed during a fever. A bony mass soon rose upon the edges of the walls of the antrum,

* Surgical Essays, Part i. p. 171.

† Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, Vol. ii. p. 307.

projected in a sloping form, and resembled a large tea-cup, fastened upon the face. The tumour was irregular on the surface, and became too large to admit of extirpation. I am informed by Dr. Physick, that a case of fungus of the antrum, which terminated in a bony tumour, occurred to the late Dr. Jones of this city. Bordenave * has cited two cases of exostosis of the antrum, of enormous magnitude and of very solid texture. In one the patient was cured by the knife and cautery. The other was too large to admit of an operation; and, after death, was found, upon dissection, smooth, polished, and extremely hard on the surface, less compact internally, and resembling very much the structure of a pumice stone. Boyer † relates the case of a soldier, who suffered upwards of ten years with an exostosis of the left maxillary sinus, which produced epiphora, pushed the eye forward, displaced the nose and palate bones, and rendered the visage truly hideous. The disease proceeded from syphilis, and was at last cured by the long-continued use of corrosive sublimate and the liquor of Van Swieten. Many examples of supposed exostosis of the antrum have been furnished by authors: there is reason to believe, however, that most of the cases described as such have really been fungous tumours mixed wish bony particles, or surrounded by bony coverings, as in osteo-sarcoma and spina ventosa—diseases essentially different from exostosis. The monstrous tumour of the antrum contained in the Heaviside Museum, and described by Howship and Fox ‡, and the interesting specimen delineated by Sandifort §, in his account of the collections of Albinus, Rau, and Van Doveren, were undoubtedly fleshy excrescences incorporated with considerable portions of bony matter.

The alveolar processes of the upper jaw are subject to exostosis. In several instances I have removed, from the

* Memoires de l'Academie Royale de Chirurgie, Tom. xiii. p. 408.
† Traité des Maladies Chirurgicales, Tom. vi. p. 168.
‡ See Howship's Observations in Surgery, and Fox on the Teeth.
§ Museum Anatomicum, Vol. ii.

gums, tumours partly sarcomatous and partly bony. In one case, I took from the alveolar processes of the left side of the upper jaw of a negro woman, forty years old, a very solid exostosis, which carried before it several of the teeth. The tumour equalled in size a walnut, and was so completely identified with the jaw, as only to be removed by Hey's saw and a strong bistoury. The complaint never returned. Cullerier* gives the history of an exostosis seated on the right side of the upper jaw, just above the canine teeth and the adjoining molares. Pelletan supposed the tumour to contain a fluid, while Dubois considered it a fungus from the gums. It turned out, however, a very solid exostosis, and was successfully removed by the chissel and mallet.

In the lower jaw I have seen both the circumscribed and tuberculated exostosis. The former is most common, and generally seated between the angle and symphysis. In the splendid work on the bones, by Chesselden†, there is a fine representation of an enormous irregular exostosis, which originated from fracture, gradually increased for twenty years, and then caused the patient's death. Gooch‡ relates the case of a woman, whose lower jaw was enlarged in its whole substance from the angle to the chin, was very prominent, and measured fifteen inches in circumference from those points: notwithstanding its magnitude, the tumour occasioned very little impediment to the motion of the jaw; nor was it painful. It had been growing between two and three years, and arose without external injury. The patient enjoyed perfect health. Several French writers, especially Bordenave§, have described, under the title of exostosis, very large bony tumours of the lower jaw; but, in every instance, so far as can be determined from their histories, they have appeared to me cases of spina ventosa,

* Dictionnaire des Sciences Medicales, Tom. xiv. p. 228.
† Osteographia, or the Anatomy of the Bones, Tab. xlii. fig. 2.
‡ Chirurgical Works, Vol. ii. p. 69.
§ Memoires de l'Academie, Tom. xiv. p. 123.

or of osteo-sarcoma, and, as such, shall be noticed hereafter.

The humerus is subject to every variety of exostosis. The circumscribed and spinous are most common. Several specimens, in the Wistar Cabinet, have these varieties blended. In four examples, the bone is uniformly enlarged, from near its head, almost to the middle; and from this enlargement several spinous processes above an inch long project. Plate II. fig. 1.* The condyles and head of the bone are free from disease. Sandifort † has described and delineated an exostosis which arises at the middle of the humerus by a narrow neck, forms an arch, and is then implanted by a bulbous extremity into the shaft of the bone—leaving a space between it and the tumour. In other examples by the same writer, several spinous processes start in a cluster from the os humeri, immediately below its head. Again, single tuberculated oxostoses spring from the neck of the humerus, and resemble the great trochanter of the thigh. Several circumscribed exostoses, also of considerale magnitude, are described as occupying half of the humerus.

Exostosis of the scapula is extremely rare. Sir A. Cooper ‡ never met with the disease. Sandifort § mentions an instance where bony depositions, in great profusion, covered the acromion and coracoid processes, and surrounded the head of the humerus.

The bones of the fore-arm are seldom affected by exostosis. I have three specimens in my collection—two of the ulna, and one of the radius. The tumours are smooth, circumscribed, seated about the middle of the bones, and the size of a walnut. I have never met with genuine exostosis of the metacarpal bones, or fingers, although spina ventosa of these bones frequently occurs, as will be shewn subsequently.

Venereal exostosis of the clavicle is by no means unfrequent; but I have seen one instance only where it was inde-

* This Plate will be given in No. II. † Museum Anatomicum.
‡ Surgical Essays, p. 174. § Museum Anatomicum, Vol. i. p. 222.

pendent of that complaint. The tumour was larger than an egg, circumscribed and smooth, occupied the middle of the clavicle, and arose from external injury. The patient was a labourer, forty years of age, and sustained no inconvenience from the swelling.

The ribs are sometimes studded over with small exostoses, and in some rare instances considerable bony masses are thrown out between the intercostal spaces. There is a specimen of this kind in my collection, which was found by Dr. Lawrence, on the battle ground near New Orleans. Dr. Godman, also, lecturer on anatomy in this city, has a very beautiful preparation, taken from one of the inferior animals, illustrative of the effect of external injury in the production of ossific deposition—bony plates being thrown out on the external and internal surface of the chest, forming a complete case, and uniting several of the ribs closely together.—A very interesting case is related by Mr. Giffard *, of a patient who died from peripneumonia, occasioned by an osseous substance, the fourth of an inch thick, six inches long, and three broad, extending under the third, fourth, fifth, and sixth ribs of the right side. On the same side, towards the back, another bony substance was found connected to the bodies of the vertebræ and ribs. The patient had been troubled, for many years, with cough and difficult respiration, arising from the exostoses, which finally caused so much irritation as to destroy him.—Sir A. Cooper mentions the case of a lady, who had a very large and painful exostosis seated on the ribs, behind the right breast. The patient was almost exhausted when he saw her, and died soon after; but no opportunity of dissecting the tumour occurred.

[*To be continued.*]

* Philosophical Transactions, Vol. viii. p. 505.

XV.—MISCELLANEOUS.

Society for the Encouragement of Arts, Manufactures, and Commerce.

This Society commenced its session on the 7th day of November last, under the most favourable circumstances; its numerous list of Subscribers being very considerably augmented by the election of many new Members; and its funds increased by a legacy, to the amount of upwards of 500*l.*, bequeathed to the Society by the late Dr. Anthony Fothergill.

The communications made to the Society, in the different classes of Agriculture, Mechanics, Manufactures, &c. are many; particularly in that of Mechanics: insomuch, that that Committee has been under the necessity of sitting two evenings in every week, to enable it to meet the increased demands upon its attention: and, in fact, it now affords one of the best opportunities of acquiring *practical information* that can be met with. Its meetings, therefore, are very fully attended by the Members of the Society; and also by their friends, who, under proper regulations, have the permission of being introduced.

The Committee of Manufactures have also been much occupied lately in examining and recommending for rewards some important improvements on Silk Looms.

The XXXIXth Annual Volume of the Transactions of the Society, just completed, contains much valuable information. Amongst other important communications, are the following:

Mr. Peter Barlow's Improved Apparatus for ascertaining the Local Influence of a Ship's Guns, &c. on the Compass.

Mr. Henry Earle's Bed for Patients under Surgical Treatment.

Mr. Jacob Perkins's Instruments for ascertaining the best Sailing Trim of Ships.—Also his Method of Warming and Ventilating large Rooms, Manufactories, &c.

Mr. George A. Witty's Fire Escape.

Mr. Ezekial Baker's Improved Bullet Mould.

Mr. Joseph Goodwin's Spring Cross, or Break, for Horses.

Mr. C. Brandt's Spring Crutch, for Pendulums.

Mr. James Storey's Portable Oven.

Messrs. W. Bishop and Co.'s Flintshire Mill-stones.

Mr. William Salisbury's Mats, made of the *Typha Latifolia*.

Mr. Benjamin Rotch's Arcograph.

Mr. George Steart's Lino-Stereo Tablets.

Dreadful Effects from the use of Iron Cement.

"Maidstone, November 6, 1821.

"A MOST melancholy accident occurred in this town on Saturday evening: Mr. Cowen, jobbing smith, was reparing the inside of the boiler of a steam engine, at the brewery, in the West Borough, belonging to William Baldwin, Esq. and in joining on some pieces of iron, he made use of a cement composed of sal-ammoniac, sulphur, and iron turnings, which produced such a quantity of fume, or gas, that it overpowered Cowen, and he, in a few moments, was suffocated.

"William Pearce, his man, being at work on the outside, and hearing a struggling noise within, got through the aperture at the top, which was but just large enough to admit his body, and was descending to his master's assistance, when he inhaled the fumes, and fell to the bottom.

"An alarm was immediately given, and a man named Oliver attempted twice to descend, but was so powerfully affected by the effluvia, that he was compelled to relinquish the task. A large quantity of water was now thrown into the boiler, and, after some minutes had elapsed, the bodies

were extricated. Pearce was found quite dead; but some appearance of life was visible in Cowen, who was immediately taken home, and surgical assistance promptly obtained. Every means that could be devised were resorted to; but all the efforts made to restore animation proved unavailing, and he expired about three o'clock on Sunday morning."

The public is highly indebted to the individual who has drawn up and published this melancholy detail: and more particularly for the accurate statement of all the circumstances attending the accident. As the employment of the excellent Cement described is continually occurring; and the hydrogen, and other gases, produced by the chemical action of the sulphuric acid of the sulphur, and the muriatic acid in the sal-ammoniac upon the iron and ammonia, are of a most deleterious nature, the ill effects of them cannot be too much guarded against—by continually blowing streams of fresh air into the boilers, &c. during the continuance of the operations therein performed, so as to drive out those gases, as fast as they are extricated.

It is very much to be wished, that other individuals, of sufficient capability, will be induced to afford accurate details of any accidents which may occur, in the very numerous processes continually carrying on in this great manufacturing country, from the chemical action of the materials employed upon each other; so as to put the public upon the watch, to guard, as much as possible, against their prejudicial effects; and, thereby, prevent that great waste of life which is continually occurring. Any information hereon will be gladly received by the Editor, and immediately communicated to the public through this channel of intelligence.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since November 24, 1821.

To Thomas Parkins, of Skinner Street, Bishopsgate Street, in the county of Middlesex, Merchant, for his improvement, or Improvements, in Printing. Dated November 24, 1821. To be specified in six months.

To William Baylis, junior, of Painswick, in the county of Gloucester, Clothier, for his Machine for Washing and Cleaning Clothes. Dated November 27, 1821. In two months.

To Thomas Motley, of the Strand, in the county of Middlesex, Patent Letter Maker, and Brass Founder, (being one of the people called Quakers,) for certain Improvements in the Construction of Candlesticks or Lamps, and in Candles to be burnt therein. Dated November 27, 1821. In six months.

To Robert Bill, of Newman Street, in the parish of St. Mary-le-bone, in the county of Middlesex, Esq. for his Improvement in the Construction of certain descriptions of Boats and Barges. Dated December 5, 1821. In six months.

To Charles Broderip, of London, Esq., now residing in Glasgow, for his Improvements in the Construction of Steam Engines. Dated December 5, 1821.

To Henry Ricketts, of the Phœnix Glass Works, Bristol, in the county of Somerset, Glass Manufacturer, for his Improvements in the Art or Method of making or manufacturing Glass Bottles, such as are used for Wine, Porter, Beer, or Cyder. Dated December 5, 1821. In two months.

To William Warcup, of Dartford, in the county of Kent, Engineer, for his Improvements upon a Machine for Washing Linen Cloths, Cotton Cloths, or Woollen Cloths, whether in the shape of piece goods, or of any article made

up of linen cloth, cotton cloth, or woollen cloth. Dated December 10, 1821. In two months.

To William Horrocks, of Portwood within Binnington, in the county of Chester, Cotton Manufacturer, for his Improvement in the Construction of Looms for the weaving of Cotton or Linen Cloth, by Power, commonly called Power Looms. Dated December 14, 1821. In two months.

To James Winter, of Stoke-under-Hamdom, in the county of Somerset, Gentleman, for his Improvements in a Machine for Sewing and Pointing Leather Gloves, with neatness much superior to that which is effected with manual labour. Dated December 19, 1821. In two months.

To Samuel Briarley, of Salford, in the parish of Manchester, and county of Lancaster, for his Improved Method of preparing Raw Silk, and cleansing the same, for the purpose of Dying and Manufacturing. Dated December 19, 1821. In two months.

To John Gladstone, Engineer and Mill-wright, of Castle Douglas, in the stewartry of Knightsbridge, and county of Galloway, in North Britain, for his Improvement, or Improvements, in the Construction of Steam Vessels, by the application of Steam, or other Power. Dated December 22, 1821. In six months.

To Julius Griffith, of Brompton Crescent, in the county of Middlesex, Esq. in consequence of discoveries made by himself, and communications made to him by Foreigners residing abroad, for certain Improvements in Steam Carriages, and which steam carriages are capable of transporting merchandize of all kinds, as well as passengers, upon common roads, without the aid of horses. Dated December 20, 1821. In six months.

THE

TECHNICAL REPOSITORY.

XVI.—*Specification of the Patent granted to* WILLIAM EVETTS SHEFFIELD, *of Somers Town, in the Parish of Saint Pancras, and County of Middlesex, Gentleman; for an Improved Apparatus and Furnaces, for separating Metallic and other Substances from their Ores, or whatever Matters may be combined, united, or mixed with them; and in the application of the same.—Dated* 31*st Oct.* 1812.—[Continued from p. 18.]

WITH TWO PLATES.

PLATE VII. fig. 3, represents my improved pot or vessel for separating zinc from the ores thereof; in which *a*, *a*, denote the sides of the pot; *b*, the hole for charging; and *c*, the pipe for conveying the metallic fumes to the condenser: *d*, is an additional pipe, reaching from *c* to the top of the charge of ore and coaly matter; and the said pipe being made of the same material as the pot, and being perforated on all sides by many holes, serves, with great facility, to convey the sublimed zinc into *c*, instead of the same being, as heretofore, compelled to find its way through the whole or greatest part of the said charge: *e*, is a side communication, from the upper part of the pot to the place of condensation, or condensing vessel, without; and the said communication serves to carry off a large part of the zinc by distillation, instead of the same being forced downwards, or left to be consumed and dissipated in flame, whenever the cover is removed for renewing the charge, or taking out the exhausted materials: *f*, is the cover to

XVII.—Messrs. W. Bishop *and* Co.'s *Discovery, and introduction to actual use, of a Mill-Stone of superior quality, found in Halkin Mountain, Flintshire**.

The discovery of a Quarry of Millstone in Halkin Mountain, near Holywell, has deservedly entitled Mr. Bishop to a small gold medal. Hitherto no mill-stones for grinding wheat at all comparable to the French Buhr had been discovered in Great Britain; and in the time of war, serious inconvenience had been felt from the scanty and uncertain supply of so essential an article. Mr. Bishop and his partners have had the good fortune to discover, and the perseverance to bring into fair trial, a stone, which, judging from the specimens laid before the Society, and from very satisfactory testimonials from all the millers who have made use of it, bids fair, in a great degree, if not entirely, to supersede the necessity of having recourse to a foreign and too often hostile country for the means of preparing our daily bread.

The qualities which fit a stone for grinding corn, especially wheat, are—hardness, to prevent it as much as possible from wearing down by the constant friction to which it is exposed; a certain degree of tenacity, to prevent the grinding surface from scaling or chipping off; and a cellular structure, in order to increase the quantity of cutting surface; the walls of the cells being at the same time thick enough to resist the strain upon them.

The advantages hence resulting are; that the flour is in no material degree contaminated by the mixture of earthy particles abraded from the stones; the grinding is expeditiously performed; the bran is completely disengaged from the flour; and the flour itself is very little heated by passing through the mill. This latter circumstance is of great importance; it being found, by experience, that flour

* From Vol. XXXIX. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce, page 55. The Isis Gold Medal was voted to Messrs. Bishop and Co. for this discovery.

over-heated, or *killed*, as the technical phrase is, will never produce bread so light as that which is ground cool.

In some parts of the valley of the Seine and of the adjoining districts in which the fresh-water lime-stone occurs, is found a siliceous rock, in detached masses or blocks, of various size, known on the spot and in commerce by the name of *Buhr*. It is a substance intermediate between horn-stone and chalcedony, and possesses, in an eminent degree, the qualities which peculiarly fit it for grinding wheat. All the fine flour required for the supply of the metropolis and of the other large towns in this island, is prepared by means of mill-stones of French buhr; a circumstance which, beside rendering us dependent on foreigners for so essential an article, is the occasion, in time of war, of enormously enhancing the price, and subjecting our millers to great inconvenience.

The northern shore of the Isle of Wight is the only district in this country in which the fresh-water lime-stone has hitherto been found, but it does not appear to contain any buhr-stone. The entrochital chert or horn-stone (vulgarly called *screw-stone*) which occurs interstratified with the mountain lime-stone in Derbyshire, as it resembles buhr-stone in quality and texture, has occasionally been made trial of for a grinding-stone, but always unsuccessfully, on account of its fragility and softness.

In the year 1816, Mr. Thomas Hooson, of Flint, observed on Halkin Mountain a bed of remarkably fine porcelain clay, which, on exposure to the potters' fires, was found to assume a more delicate whiteness than any substance of a similar nature hitherto found in this kingdom; and seeing also other substances which he thought likely to be useful to the potters, he obtained from Earl Grosvenor a lease of all clays, rocks, and stones, except lime-stone, within his lordship's liberties; and subsequently, with a view to an extended trade, formed his present partnership with Mr. Richard Fynney, Mr. William Bishop, and Mr. James Whitehead, established under the firm of The "Welch

Company at Nant y Moch, near Holywell," where they have erected works for preparing the clay, which is called "Cambria," for sale, by separating it from a white siliceous sand and rock, with which the bed is found mixed to a depth at present unknown, but which has been proved as deep as 26 yards. The sand, when separated, is used for glass-making; and the white siliceous rock, now called "Rock Cambria," is ground down and used in the composition of China and earthenware, instead of ground flint, or is mixed with it. For this process of grinding, several thousand tons of chert are annually consumed in the Staffordshire potteries, and much is supplied from Halkin mountain. In quarrying this chert, some of it in the state of vesicular entrochital horn-stone was raised, which, when used together with common chert, indicated such a superiority by its expeditious grinding and its little wear, and shewed such a proximity in appearance (after having been worked) to the French buhr; that its use for grinding wheat was considered probable; and this led to the first application of the vesicular Halkin rock as a buhr-stone.

Halkin Mountain (called "Alchene" at the Conquest, according to Pennant) is a range of high uncultivated land, in Flintshire, the mineral property of the right honourable Earl Grosvenor. On the inland side it runs parallel to the boundary hills of the Vale of Clwyd; and on the north-east stretches from Holywell for about four miles till nearly opposite Northop, in an angle of about twelve degrees with the river Dee, and averages about a mile in breadth. It is composed of mountain lime-stone, with the usually accompanying rocks, and abounds with large veins containing lead ore, blende, and calamine, with some appearances of copper; it also affords a rock of a whitish quartz, well adapted for certain kinds of mill-stones, for which (according to all our old historians) Flintshire has been famous. But these quarries had been neglected for many years, till lately re-opened by the discoverers of the still more valu-

able buhrs; and promise to regain their celebrity as grey-stones, for grinding oats, &c.

The buhr-stone itself, or entrochital horn-stone, is found near the middle of the eastern ridge of Halkin Mountain, and on the west side of the ridge, into which it penetrates with a dip of about one yard in six. Its present appearance presents a bed of about four yards thick, between two layers of a compact siliceous slaty chert, covered with a shivery siliceous shale. It dips eastwardly, like all the other strata on the mountain, which consist of lime-stone rock and chert. The buhr stratum is principally of the same quality as the small mill-stone sent herewith, and attested by Dr. Traill (Certificate, No. 1); but rotten masses sometimes occur, and blocks are occasionally found of too close a texture for the miller; and some few are quite solid. Still the corallite structure pervades the whole; the entrochites being perfect and entire in some instances, while in the chief parts of the bed the casts alone remain; thus leaving the rock vesicular, and in this respect differing from the nature of the pores in the French buhr, which appear to have been caused by corrosion, their edges being rusty and impure; whereas those in the Halkin buhrs are of pure flint, and exceedingly sharp and hard.

The quarry from which all the buhrs hitherto used have been procured, now presents a fore-breast of forty yards, and is of the same quality and thickness as at first, but has a thicker covering of shale as it dips into the hill. At the distance of a mile to the north-west, a second quarry is now opening, and appears similar in every respect to the former; and from fragments of buhr here and there found, with pieces of shale and of chert, half concealed in the mountain turf, traces of the same stratum may be observed from the one quarry to the other. About half a mile to the south-east of the main quarry, in the same chert-formation, the buhr-stone is also seen to crop out; and in the valley at the foot of the ridge, where a thick bed of lime-stone forms the upper stratum, with a sub-stratum of chert,

the miners, in their search for lead-ore, have met with the buhr-stone at the depth of 160 yards from the surface.

In order to prove the Halkin buhrs, the discoverers had some made into mill-stones, which they set up in a neighbouring mill in the borough of Flint; some were had by a mill-wright, and afterwards sent to a mill at Dunham-o'-th'-Hill, mixed with French buhrs; and one large buhr was shaped into a mill-stone, and put up at a mill at Ysceifiog.

They considered it would require much time to prove the real character of the buhrs, and that it would be useless to endeavour to make sales till this proof could be satisfactorily made; and therefore they took but little trouble in circulating the object of their discovery for nearly two years, when finding that the stones at Flint mill were highly approved, and found to be a substitute for the French buhrs, they turned their attention to the subject.

They were advised to lay specimens of the buhrs before the Society of Arts, &c. immediately, lest they might be anticipated by some other person in their pretensions to the premium offered; and they accordingly ventured to do so, in February, 1820, (under the name of Flint Buhrs); but not having then had sufficient trial made of them, they were not in possession of Certificates sufficiently extensive on which to rest their claims to the notice of the Society.

As, however, they are now able to adduce proofs that the Halkin buhrs are fully equal to the French, and in some cases are declared to be actually superior to them, they trust that the Society, in looking to the national importance of the discovery, will pass over the trouble that was last year so unintentionally occasioned, and again take the matter into their consideration.

They request permission to lay before the Society the accompanying Certificates and Letters on the subject; and, in order to shew that they have not been selecting a few, and withholding any less favorable to their hopes, they beg to state the result of every sale made by them up to

the end of the last year; and to add a short review of the particular certificate connected with each case, observing at the same time that not one unfavorable or unsatisfactory trial has yet occurred.

Some of the buhrs, got on the discovery of the quarry, were (as before stated) converted into mill-stones, and put up about three years ago at Mr. Evans's mill, in the borough of Flint; who certifies, that "he used them nearly two years occasionally for wheat, but chiefly as grey-stones, in which they excelled: that at first he used them seldom for wheat, but afterwards more and more frequently, as he found them answer the purpose: and, by way of comparing them with the French stones, he took six measures of wheat, and ground one-half on the Halkin stones, and one-half on the French stones: there was some very slight difference in the flour, which was in favour of the French; but he did not consider it as a fair trial, as the Halkin stones were not at the time properly faced for wheat-grinding; and if the French stones had been faced as rough, the flour from them would not have been better than the other. Bread was made from the two kinds of flour, but no one could distinguish between the two. He then had the Halkin stones regularly faced and cracked as French; and has found them ever since equal to the French stones in every respect whatever."

Others of the buhrs, got about the same time, were used more cautiously by a mill-wright, who made a large pair of mill-stones of Halkin and French buhrs, fixed in alternately; and these were set up more than three years ago at the Horn-mills, near Dunham-o'-th'-Hill, in Cheshire. Mr. John Peers, the present tenant of this mill, entered on it nearly three years ago; and he states that "the stones were in a rough state, and required six months to get them to a proper face, when they ground wheat as well as the best French stones, and have ever since continued to do so; that he prefers the Halkin and French stones mixed to those of French buhrs entirely, as they grind faster, and

as well, and full as cool as the French; that he uses them for all purposes, and considers them equal in every respect, and superior in some respects, to the French buhrs."

A large buhr, got about the same time, was sold to Mr. John Edwards, the occupier of a small mill at Ysceifiog, in Flintshire: he states, "that from various causes the buhr was not used till about twelve months ago, when he shaped it into a mill-stone of three feet six inches diameter; that he has no French stones, but used this as a runner over a blue stone for grinding wheat, and found the flour of good colour, and the bran broad and light; that the stone would bear the finest cracking, and continued to improve and harden till he left the mill in November last."

The next sale was to John Dumbell, Esq. of the Mersey Mills, Warrington (said to be the largest establishment in the kingdom, and containing twenty-two pair of mill-stones): and he certifies, that "in March, 1820, he received a quantity of Halkin buhrs, which he had forthwith made into mill-stones; and these were so much approved, that in May, 1820, he had buhrs for a second pair; that the two pair of Halkin mill-stones have been regularly at work ever since, and continue to give great satisfaction to the bakers and flour-dealers; that he conceives they are precisely the same kind of stone as the French buhrs, and cut the grain like them; and are like them in respect to oatmeal, in which neither French nor Halkin stones are used to advantage; and he considers the discovery of great national importance." Messrs. Hurstfield and Passand (now the occupiers of some large mills at Lymm, near Warrington, but who were lately foremen to Mr. Dumbell, and have been practical millers nearly thirty years), state, "that they made the Halkin stones which were set up at the Mersey Mills, where there are nine pair of French stones at work; that they made an experiment with some wheat, by grinding some on the best French pair, and some on the Halkin stones, in order to compare the flour; in which there was scarcely any perceptible difference, though the preference

was given in favour of the Halkin stones by a corn and flour dealer, to whom the samples were shewn; that bread was made from each, but no difference could be perceived; that at first they thought the Halkin stones not quite so hard and tough as the French, but they found them continue to improve, and to become as good as French; that they have seen all varieties of mill-stones, and made all sorts of mill-stones, but never saw any buhrs to come in competition with the French, except the Halkin, which they are satisfied will answer every purpose."

In corroboration of these statements, a sample of the bran (sifted in its rough state out of the flour) is respectfully submitted to the Society.

In May, 1820, a Halkin mill-stone was sent to Mr. Pratt, of Saredon Mill (a large concern near Walsall, in Staffordshire), and set to work in his mill at Dudley. Mr. Pratt has had a very extensive practical experience for more than thirty years; and in October last he wrote, that "it had been applied for several weeks in grinding wheat; and that it ground equal to French stones, and better than some of them; but he had it for grinding barley, &c., and was so using it, and found it answer remarkably well for that purpose; that the face and dress keep good, and for a great length of time; and that in the Spring he would have a pair of Halkin stones to grind wheat." Upon application to Mr. Pratt for the result of his further experience, he writes again on the 26th February, that "he gave a just report of the good qualities of our Halkin mill-stone in October last, and entertains the same opinion to the present day; but that it had been grinding barley, &c. ever since; and he never before met with any stones to bear hard grinding so well, and continue the dress so long."

In June, 1820, Mr. Stephens, the owner and occupier of a steam-mill in Harrington, Liverpool, having a desire to try the Halkin buhrs, obtained a buhr, which he broke into several pieces, and fixed them into different parts of a pair

of French buhr mill-stones; and he certifies, that "they have since worked to a good face, and crack as well as the rest of the stones, and, as far as his opinion can be formed by such a circumstance, he considers the Halkin equal to the French buhrs." He states also, "that he has, at the request of the discoverers, taken out one of the pieces of Halkin buhr from his mill-stones;" which they beg to offer to the attention of the Society, as a convincing proof of the toughness and hardness they manifest after a few months' wear, being in this respect also like the French buhrs.

In August, 1820, a pair of Halkin mill-stones, of five feet diameter, were sent to Messrs. Pilling and Co.'s large mills, at Mirfield, near Leeds, who have not yet given any written report of the stones; but Mr. Goodwin, of Liverpool, (a mutual friend of Mr. Pilling, and of the proprietors of the quarry,) states, that he lately had a conversation on the subject at Mirfield with Mr. Pilling, who stated, "that the stones were not quite so uniformly porous as the sample buhr, and had rather chipped in facing; that they mended of this every time they were faced, and were evidently tougher the longer they worked."

[*N. B.* It is intended to send up Mr. Pilling's own report, by way of supplement, as soon as it can be procured.]

In September, 1820, a pair of Halkin mill-stones was put up at the Aughton Water-mill, near Ormskirk, Lancashire, occupied by Mr. Richard Rawsthorn, sen., who has been a practical miller all his life, and is 74 years old; and he states, that "they answer better than French, for they grind cool, and make fine flour, cut bran thin and broad, and crack as fine as any French stone."

In September, 1820, a Halkin mill-stone was also put up at a new wind-mill at Knotty Ash, near Liverpool; and Messrs. Marr, the tenants, declare, that they "laid down a pair of French buhrs, and a short time after laid down a French and Halkin; that the latter work equally well as the French; stand cracking as well; have been dressed four times, and still improve; soften the wheat as well or better

than French do; and cut very broad bran, and preserve the colour as well as any French stone."

In October, 1820, a pair of Halkin mill-stones were sent to Messrs. Hudson and Co., of the King's Mills, Leeds. By a Letter from them, it appears the stones are not yet in use, so that no positive proof can be had of their grinding; but they say, "that their millers, who have prepared the stones for work (from which they can form a good opinion of their qualities in comparison with French buhrs), give them a favorable opinion that they are likely to answer."

In November, 1820, a pair of Halkin mill-stones were consigned to Richard Robinson, Esq. of the Phœnix Iron Works, Dublin; but they were delayed for a long while by stress of weather, and have not yet been put to work: Mr. Robinson, however, says, that "they have undergone a very close examination by some of the first mill-wrights and millers, who all agree that they appear equal to the French buhrs, and in some instances superior;" alluding (it is supposed) to the equability of the pores.

In December last, Richard Sanky, Esq., banker in Holywell, Flintshire, and owner of a large windmill there, having a pair of French mill-stones which did not give entire satisfaction, removed the runner, and put up a Halkin mill-stone in lieu of it; and he certifies, that "his tenants like the work done by these better than by the other pair of French stones in the mill; that they clean the bran better; that the flour is soft and of good colour; and the stone keeps its face well, and gives satisfaction in all respects."

The discoverers beg permission to declare further (and are ready to do so on their oath if desired), that the several Certificates above mentioned have been given voluntarily and gratuitously; and that the several persons giving them have no concern or interest in the quarry; and that, up to the end of the last year, no Halkin buhrs or mill-stones have been disposed of in any instance, except those before mentioned; namely,

Mr. Edward Evans, Flint Mill, Flintshire.

Mr. Peers, Horn Mills, Dunham-o'-th'-Hill, Cheshire.

Mr. John Edwards, Ysceifiog, Flintshire.
J. Dumbell, Esq. Mersey Mills, Warrington, Lancashire.
Mr. Pratt, Saredon Mill, near Walsall, Staffordshire.
Mr. Stephens, Steam Mill, Harrington, Liverpool.
Messrs. Pilling & Co. Mirfield Mills, Dewsbury, Yorkshire.
Messrs. Hudson and Co., King's Mills, Leeds, Yorkshire.
Mr. Rawsthorn, Aughton Water-Mill, Lancashire.
Mr. Marr, Knotty-Ash Windmill, near Liverpool.
Richard Robinson, Esq. Phœnix Iron-Works, Dublin.
Richard Sankey, Esq., Banker, Holywell, Flintshire.

They have therefore offered to the Society all the evidence which it is possible to produce; and trust, that when the various testimonials (collected from different sources, and from persons who have had no communication with each other, though all agreeing in approbation) shall have been compared, the Society will be pleased to honour the Halkin Buhrs with their sanction.

W. Bishop & Co.

The several samples alluded to in the preceding report, are placed in the Repository of the Society.

CERTIFICATES,

from all the persons named in the preceding statement, accompanied the communication of Messrs. Bishop and Co.; of which the following, as being the most important, are subjoined:

N° I.

Liverpool, March 3d, 1821.

I have this day examined the small mill-stone, of Flint buhr-stone, measuring 11½ inches in diameter, which is about to be sent to London for the inspection of the Society of Arts; and hereby certify, that it is a fair specimen of the rock in the quarry on Halkin Mountain, which I visited last year. A vast quantity of stone, of a quality equally excellent with this specimen, may be procured from Mr. Bishop's quarry on Halkin, in Flintshire.

Thos. Stuart Traill, M.D.

N° II.

SIR, *Mirfield Low Mills, March 7th*, 1821.

After having tried your Halkin buhr-stones, for a fair and sufficient time, we are now enabled to lay before you a candid and faithful report of their quality; and this we shall endeavour to do with as much brevity as is consistent with the importance of the subject.

The perfection of grinding consists, in reducing grain to a requisite degree of fineness, with the least pressure; or, in other words, to make the best and the greatest quantity of flour, out of a given quantity of wheat, with the least pressure. But the mere good quality of a stone cannot effect this; for we must now call in the aid of art. And here it is that the great art of a miller consists,—the putting of work into stones, or the obliquity and disposition of the furrows; every thing else compared with this being only trifles. And, indeed, when we consider that an accurate knowledge of this is grounded upon the doctrine of central forces, which constitutes an important branch of the Newtonian philosophy, we need not wonder that so few understand the real principles of corn grinding. We have, however, reasons to believe that we have considerably improved it.

From these observations it appears, that though the quality of the stones may be equally good, the effects produced will be different, according as the work is scientifically put in, or otherwise; but if the work and velocity of the stones be the same, we can clearly ascertain the quality of them, by the effects produced.

We will now apply these observations to the stones in question. After twice or thrice taking them up, we were afraid that they would not stand the crack well; but this fear was soon dispelled, as we now find that they were exceedingly little, and that the crack stands as fine as a hair. We now proceeded to ascertain the quality of the bran, compared with that from our French stones; and, for this purpose, we sifted the meal from every pair of stones as it came from the mill-eye: the bran thus retained in the sieve, we placed

by itself, and by this means we had an opportunity of comparing the whole together. This we have repeated no less than forty times; and the result has always been obviously, from the very first glance, that the bran produced from the Halkin buhrs was not only cleaner, but of a more uniform cut; and this has not been perceived by millers alone, but by every person that has accidentally come into the mill.

This we think is quite sufficient to prove the superiority of the Halkin buhrs; but, that every possible doubt might be removed, we had recourse to the following experiment.

We selected the best French stones in the mill, made by the late Mr. Gardiner of Liverpool, who was very famous for his knowledge of French buhrs; and, that the experiment might be the more accurate, we did not grind a quarter of wheat on each pair of stones; as it is impossible to part it from the wheat, that precedes and succeeds, with that degree of nicety that is required, without running the stones empty, and thereby injure them very considerably. But we weighed 480 pounds of meal, ground by each pair of stones, from the same wheat, weighing 57 pounds the bushel. These two parcels, after remaining a week, were weighed again, to see if any accession or diminution of weight had taken place; but the weights were precisely the same as before. The two parcels of 480 pounds each, were then dressed, and the result was as follows:

Flour from the Halkin Buhrs	390 pounds.
Flour from the French Buhrs	384
Difference in favour of the Halkin Buhrs,...	6

Now, in this experiment, the velocity and work of the stones being the same, the quality of the buhrs may be as justly inferred from the effects, or quantity of flour produced, as any other cause in philosophy from its effects.

We remain, Sir, &c. &c. &c.

J. & W. PILLING.

XVIII.—*On English and Foreign Copper, Zinc, and Brass.* *By the* EDITOR.

THE great inferiority of the English brass, in comparison with that imported from the Continent, is well known, and its ill effects experienced, in many of our manufactures; although not manifest to the public at large. It is with a view of pointing out the causes of these defects, and their remedies, that the Editor has furnished this article.

It is well known that leaf copper, commonly termed Dutch leaf, is not manufactured in this country, but is always imported from the Continent; and, in time of war, is exceedingly scarce and dear. It is not, however, generally known to what treatment copper has been subjected, to render it sufficiently malleable, to undergo the operation of being beaten into leaves. This, it will be the object of an article in a future Number of this work to explain. It is only necessary now to mention, that copper must be brought into that state, before it can be united with *pure zinc*, to form a brass equal in *malleability*, *ductility*, and *durability*, to the foreign brass.

An article in this present Number, being the completion of the specification of one of the late Mr. Sheffield's Patents, explains the modes by which *pure zinc* may be obtained from its ores.

It may be well to point out some of the defects which exist in the ordinary English brass, and the causes thereof. It is well known that brass is usually made, in the large, by cementing copper, in a divided state, with calamine, or other ores of zinc: the copper, which has not been treated in a proper manner, as above alluded to, is thus made to unite with the crude zinc, and to partake of the lead and other metals, which generally contaminate it, in its *blendes* or ores; and the consequence of which is, the great want of malleability and ductility of the English brass; and, which is still worse, its great liability to become decomposed, in a

certain peculiar state of the atmosphere, when the united actions of cold and moisture operate upon it; as in a thaw, for instance: and the consequence of which is, that it becomes black and rotten; an evil which most persons must have experienced.

Now, from this last and most serious inconvenience, the best foreign brass is entirely free; and, consequently, large sums of money are annually laid out in the purchase of this article.

The best brass-wire strings for piano-fortes are made of this foreign brass. The wire studs, with which glass drops for lustres are connected together, are purchased for this use, from Germany, at the price of half-a-guinea per pound. Watchmakers pay at the rate of a guinea per pound for Flemish pan brass, for their delicate wheel-work. The tinsel, for ornamenting theatrical dresses, is made of this fine brass; and, in short, to enumerate the various uses of this superior article would be endless. The late Mr. Sheffield, after obtaining his Patents, circulated prospectuses of the advantages to be derived from his inventions; and was busily engaged in establishing works in Derbyshire, with a view to carrying them into effect, when his useful labours were terminated by a paralytic attack, which eventually occasioned his death. We have, however, the satisfaction to state, that he has left relatives, and, amongst others, a son, whom he made thoroughly acquainted with his superior processes; and who is capable of carrying them into effect, should an opportunity be afforded him for so doing. We shall now proceed to give a copy of one of the prospectuses above mentioned, as follows.

Improved Apparatus for extracting Zinc or Spelter from its Ores—

A Patent for which has been taken out by W. E. Sheffield, who wishes to have it carried into effect, either by forming a Company for that purpose; disposing of the Pa-

tent to a Company already formed; or, by granting privileges to those who wish to avail themselves of the Patent improvements.

Zinc, or spelter, is used in the composition of brass, in the proportion of one-third; and, notwithstanding the immense consumption and importance of the subject, the ores of zinc, or spelter, are less understood than those of any other metal.

Mr. S. has been employed in this pursuit many years; and, from the success which has already attended the investigation of these ores, he is convinced it deserves the greatest encouragement, both in a commercial view, and as a source whence much profit might be expected, with very little risk indeed. The makers of brass purchase only the richest and purest ores of zinc, or spelter: it will not answer their purpose, unless it contains thirty per cent. of zinc, or more: these rich and pure calamines, having been in request for several centuries, are now become scarce and dear. Calamines, less rich or pure, do not find a market at all, even at an inferior price; to the great loss of the miners, who are compelled to relinquish all those mines which do not produce a calamine sufficiently rich and pure for the makers of brass. The distress occasioned in a mining country, where the poorer calamines abound, and cannot find a sale, has occasioned Mr. S. to consider the subject, and endeavour to find a remedy; which, with much expense of time and money, he has, in some degree, accomplished; by inventing an apparatus, with which the greater part of the calamines rejected by the brass-makers may be made useful, and the zinc extracted from them to advantage—the operation requiring less time and fuel than in the usual way; by which a profit of forty per cent. per annum, on the capital employed, may reasonably be expected; and, according to the experiments actually made, may be more.

Mr. S. has also obtained another Patent for preparing copper, in a fit state for being beat out into leaves; or to

compose, with a due proportion of pure zinc, a very fine brass, either for plates or wire; and, also, an improved apparatus for dividing the plates of copper, brass, &c., to fit them for drawing: from the metals thus prepared, wire will be obtained, much sounder and stronger than by any other method*.

In order to derive the greatest advantages from the above-mentioned improvements, the same Company should possess both Patents, and have a copper and brass work, as well as a zinc work. The whole, united, would form a regular and connected business, of great consequence; capable of employing a very large capital, which might be increased to almost any amount; and possessing and affording advantages much superior to any other Company, manufacturing similar articles, in this kingdom.

XIX.—*Method of Ventilating Coal Mines, by Mr.* James Ryan, *Director of Coal Mines (late of the Netherton Colliery, near Dudley); for which he received the Gold Medal and* 100 *Guineas from the Society for the Encouragement of Arts, Manufactures, and Commerce, Adelphi.—In a Letter to the Secretary,* Dr. C. Taylor.—[Continued from p. 44.]

The Netherton and Buffery Collieries in Staffordshire have for many years required the terrific explosions of the fire-line before mentioned, to enable the miners to work them at all; whilst the next coal-field, separated from them

* It is well known, that wire, drawn from metals which have been slit into rods, by the usual operations in the large, is constantly unsound throughout its whole length; arising from the shape given to the rods, in the act of slitting them by the cutters; which cause one edge of each rod to be rounded, whilst the opposite edge is hollowed; and the edges of this hollow side, by the operation of wire drawing, are gradually brought nearer together, until, at length, they meet and close; and thus form, as it were, a sort of tube, or hollow, along one side of the wire. In Mr. Sheffield's improved process this evil is completely obviated.

merely by a fault a few yards thick, but which has thrown its strata fifty yards higher, is entirely free from accumulations of gas.

When these interruptions to the free escape of the hydrogen gas into the open air take place, it naturally forces itself into the workings, through the largest fissures it can find; issuing out in a continual and powerful stream, which the workmen denominate a feeder or blower. By the diluting system, the gas which *thus* issues from the coal is made to traverse all the workings between the blower and the upcast shaft; remaining, it is true, on account of its levity, in the upper part of the courses; but thus insuring its ignition, through the whole extent, if, unhappily, it comes in contact with flame *.

But when, as by my method, the draught, instead of sweeping through the whole mine, is directed towards those places only in which (from their being situated above the natural current) the hydrogen gas can lodge, it is evident that the fluid, instead of being diffused through the works, is confined to the course which I prescribe to it, and therefore takes the shortest and most ready means of escape.

In a mine where the circulating current is thus, in a great measure, kept from admixture with hydrogen gas, I have never found any danger to arise from setting fire to the blower at the point where the gas issues into the works; and by inserting an iron pipe, I have often directed it so as to give light to the workmen.

But when I had driven or bored the top-heads, or holings, leading into the gas-course from the roof of the mine, and bored the superincumbent strata so as to connect the laminæ with the gas-courses, *the light from the blowers always died away*, and they ceased to discharge gas.

* Should it escape the miner's lights, the only remedy, according to the old system, is to extinguish the furnace at the bottom of the upcast shaft. Admitting that it were possible to get the fire extinguished in time, would not this be weakening the ventilating current, precisely at the moment when it is most necessary to increase its velocity?

In the old system, this circumstance is frequently produced by the falling in of the roof, and the formation of what is termed a pot-hole, (an accident so frequent, that it requires the employment of several men, in every mine, merely to watch and give notice of it,) or from the works intersecting a fissure in the coal; and produces such an increase in the quantity of gas, that the atmospheric air is insufficient for its dilution; and by thus rendering it necessary to augment the power of rarefaction, collects a quantity of burning fuel at the furnace, that cannot be speedily extinguished.

Pursuing the comparison before made, of a lodgment of air in a bent water-pipe; what would be thought of the engineer who should endeavour by force to drive it before the water, encountering in its progress perhaps twenty such bends, in preference to the application of a simple tube into the bend where the air lodged?—yet such is the process of ventilation hitherto adopted.

But this is not the only evil resulting from the present system: when approaching old and abandoned workings, in which the inflammable gas has been accumulated for several years, if, through the neglect of the director, the workmen proceed without the precaution of boring, as soon as a pickaxe penetrates into the open space of the old coal-mine, the gas rushes out and ignites by their candles; and, if the mine in which they are at work should be in a state of explosive dilution, the dreadful effects may easily be anticipated.

In my system, if by any chance such an accident take place, the consequences are trivial; the eruptive gas, instead of being confined to take its course through a labyrinth of foul air, spreads at once, by its levity and elasticity, under a roof of several thousand yards extent; and this the more certainly and rapidly, in proportion to the previous purity of the air contained in the mine: here it may burn without danger, and almost without inconvenience to the miner, who pursues his labour below this thin sheet of flame: in a

short time it would find the higher levels, and ultimately steal off through the holings into the gas-headway, while the men in that direction would naturally descend to a lower part of the workings until it had gone off: even the workmen in the gas-course, although they might some of them be scorched, would not perish, as the accelerated velocity created by inflammation would confine the flame to the roof of the gas-headway; a fact which has been proved by two instances in Buffery Colliery, at one of which I was present.

Having thus laid before the Society my new method of ventilation in all its details, as succinctly as the importance of the subject will admit, I now beg leave to state what has been done towards bringing my system into practice: and this part of my narrative is happily confirmed by numerous Certificates, which I herewith transmit to the Society, and to which I beg leave to refer.

The year 1806 was marked by several disastrous explosions in various coal-mines throughout England and Wales: in the course of that year, thirty-six men perished by two explosions at Mostyn Colliery, in Flintshire; sixteen, by an explosion at St. Helen's, in Lancashire; and eleven, by another in a colliery at Whitehaven! These events induced me to think that I could bring the system which I had so long meditated into action. I visited all these collieries in vain. I also visited Durham and Northumberland; but found here the same prejudices and opposition, which I met with in other quarters; and returned without being able to get a trial in any pit whatever. Hurt at the treatment I received, I came to London in 1807, and waited upon Sir John Sinclair, who approved highly of my plans, and immediately introduced me to the Honorable Washington Shirley, whose labours in the cause of humanity and mankind have impressed upon my mind an unceasing sentiment of gratitude:—and here I am bound to say, that

if my system has any merits, it is to his firm and persevering support it owes its being brought into action, and the perfection it has now attained.

By Mr. Shirley I was requested to proceed into Staffordshire, and was furnished with Letters to Messrs. Fereday and Smith, the intelligent mine-masters of that county. Mr. Shirley had in his Letters requested the most fiery ground to be appointed for me to work upon.

This being done, the shafts were sunk, and the works driven onward from the bottom, until the inflammable gas began to give alarm, but which ceased the instant I put my system into action: this dawning success produced much jealousy amongst the resident directors; but the firm and generous support of Mr. Shirley and the Rev. Mr. Cartwright, (both magistrates,) and of Messrs. Fereday and Smith, who personally accompanied me in all my trials, secured me from any material molestation.

At this time all the pits around me were exploded every morning by the firing process; and, on the 3d of December, 1808, I took charge of the pit next to my new one.

In this mine, I found that "air heads" had been driven, through which the air was forced from the blowing or downcast shaft to the upcast shaft; notwithstanding this, however, two explosions were daily required, previous to my taking charge; and this had continued for eight years.

Having formed my gas-course from the old works, and carried it to the higher part of the mine, the gas poured out so fast on the men cutting the drift, as to make it necessary to work without candles. I used Canton's phosphorus for light. The explosions, which in this stage of the work were still requisite, sensibly diminished in force; until the gas, escaping by my simple gas-course, rendered them no longer necessary. By way of experiment, I put up a door in the gas-headway, with a perforation in the centre, which I gradually enlarged until it was capable of liberating all the gas collected in the workings; and found that the hydrogen, which was competent to produce the

tremendous effects before mentioned, was freely permitted to escape through an aperture of only two inches square!

The only alteration I made in ventilating this pit was, to change the mouth of the air-head from the blowing to the upcast shaft, thus converting the air-head to a gas-head, and enabling the gas to escape by the shortest way.

Previously to the above period, Mr. Fereday had purchased the Buffery Colliery, where a large sum of money had been lost by the effects of its explosions: this colliery I took charge of, notwithstanding its daily explosions had swept off numbers of men; and, in three months, I rendered it sufficiently safe for the colliers to disuse the fire line: these facts are certified by the Letter from Mr. Fereday to Mr. Burn; and by Certificate No. 1.

In consequence of these proceedings, and the numerous distressing accidents which occurred in the Northern English mines, a Letter was sent from the Society for preventing accidents, &c. to Samuel Fereday, Esq., for the purpose of ascertaining how far my plan had been introduced, and what had been the results: to which the following answer was returned:—

SIR, *Bradley Iron-Works, Nov.* 1, 1814.

On my return from a journey, I find your favour of the 15th ult.; and, in reply, I beg leave to state for your information, that I am fully satisfied with the happy results which have taken place in this part of the country by the adoption of Mr. James Ryan's method of ventilating mines; and have no hesitation to say, that many hundred miners are now at work in several collieries in which I am concerned, that, but for this blessing, would, in all human probability, have long ago fallen victims to the explosions of the hydrogen gas, and which, before his plan was adopted, were so frequent. It gives me great pleasure to hear of the establishment of an institution, which has for its object the amelioration of the condition of so valuable a class of our

fellow-men: and shall be happy, if it lies in my power, to promote its views. If any information I can afford you will have that tendency, I beg you will not hesitate to apply to, Sir,

Your most obedient servant,

SAMUEL FEREDAY.

To Mr. Wm. Burn, Southwick, near Sunderland, Durham.

In the mean time, I received communications relative to these inquiries; and wrote to the above Society respecting my system, in July, 1815. I received the following Letter:—

SIR, *Southwick, 14th July*, 1815.

Your Letter of the 12th ult., and former one, have been duly received by me, and laid before the Committee appointed by the Society for preventing accidents in coal-mines. The Committee have since made the necessary inquiry of Mr. Fereday, whose report seems satisfactory; but they have had no answer from Lord Dudley and Ward: they have also otherwise endeavoured to satisfy themselves of the efficacy of your method. The result is, that they are strongly inclined to think that it may turn out to be found a highly important one; and they wish, on that account, to make it at present an object of their particular attention. It may be proper, however, to state to you, that this Society and Committee consist of few persons immediately interested in coal-mines. They have been prompted by humanity alone to endeavour to prevent the fatal accidents that are happening in the collieries: their funds are at present hardly adequate to any other purpose than that of inquiry and information. I have therefore to request you to say how far any satisfactory experiment can be made, at an expense within their compass, in a coal-mine here; so as to bring conviction to the coal-owners, that your method, if generally adopted by them, would give the security wanted. The Committee would therefore be obliged, if you could propose some plan of ex-

periment to be made in this neighbourhood, or would yourself undertake such an experiment as would convince them of the entire security of your method, and would be likely to answer the purpose of satisfying the coal-owners here. If the Committee should find it to correspond in point of effect with what they wish, you can have no doubt but that they would endeavour, by all the means in their power, to procure the compensation that such an excellent discovery would well deserve. Be so good as to drop me a line in a post or two.

I am, Sir, Your obedient servant,

WM. BURN.

To Mr. James Ryan.

In consequence of this Letter, and the inducements therein held out, I left Ireland, where I then was, in August, and proceeded to make such experiments as might answer the views of this Society. After several conferences with the Committee, and particularly with the Rev. Dr. Gray, Dr. Pemberton, and Dr. Clanny, I went over to Newcastle, in order to procure a trial of my system; but did not find any inclination on the part of the agents, &c. to assist me. After I had been there a short time, I wrote to Dr. Gray, as an active member of the above institution, wishing him to exert his influence; and received the following answer:—

SIR,

Agreeably to your request, I have written again to Mr. Buddle, having before addressed him on the subject of your experiment.

I hope that you will be allowed to make it where you wish, and under favorable circumstances. With every good wish for your success, and hoping to hear from you soon, I subscribe myself, in great haste,

Your obedient humble servant,

Sunday Evening. ROBERT GRAY.

[This Letter inclosed one to Mr. Buddle.]

Notwithstanding this, however, I found nothing but apathy prevailing, relative to any improvement in a system which had by its destructions proved itself so ineffectual; and the circumstances I before detailed will not make it appear extraordinary that considerable impediments were thrown in my way. Before the outline of my system was known, objections began to be started; and in a short time a deputation was sent into Staffordshire, to make inquiries about my system; but, unfortunately for me, they preferred the opinions of men, whose situation rendered them averse to my plans, to those of the honorable and independent characters I have before mentioned.

On their return, armed as they were with the almost absolute sway over the Durham and Northumberland mines, and additionally supplied with the partial opinions they had collected on their excursion, I found it in vain to argue the merits of my system, as the opposition was too powerful for my individual exertions. I therefore, after much trouble and expense, left Newcastle on the 24th of December, 1815, and determined to seek justice from a Society where liberality and science prevail.

Before I conclude, I wish to make one further observation on my system. It has been objected, that my gas-courses are equally liable to falls of the roof, as what the mine is: this, however, is erroneous; for, not being intended, like the mine-boards or passages, for the supply of coals, but merely to give passage to the noxious gas, they are comparatively small, and carefully strengthened throughout; in them nothing is left to chance; and this security is effected at a very little expense, as their extent is very small, compared with the courses in the old method; and, being able to work some part of them in the dark, there is no danger of explosion; but, aided by Canton's phosphorus, or, if this should not yield sufficient light, by any safety-lamp, I should feel myself perfectly secure in making the preparatory passages through a seam of coals;

or, under any other circumstance, where an explosive mixture might for a time prevail.

I beg once more to express my gratitude to the Honorable Washington Shirley, for his indefatigable exertions throughout this cause; and in which he was most zealously seconded by that sincere friend to humanity, the late Rev. Mr. Cartwright, a most upright and intelligent brother magistrate; and to Dr. Thompson, Wm. Allen, Esq. F.R.S., Alexander Tilloch, Esq., the Rev. Mr. Turner of Newcastle, and Anthony Clapham, Esq. of the same place; to whom I am likewise under great obligations for their assistance.

I have the honour to be, Sir,
Your very obedient servant,
JAMES RYAN.

CERTIFICATE, No. 1.

As inserted in the Birmingham Gazette, January 1, 1810.

We, the Charter Masters of the Buffery Colliery, near Dudley, in the county of Worcester, having suffered material disadvantages from the destructive effects of the vast quantities of inflammable air, with which the works were charged; and being conscious of the serious losses sustained by the late proprietors on account of the numerous victims to its ravages, and the impossibility of working the mine, while so dreadful a body existed in it; think it incumbent on us to declare, that Mr. J. Ryan, who was engaged in July last by Mr. Fereday, the present proprietor, to ventilate the pits, No. 2, 3, 4, has successfully superseded even the necessity of firing-lines, &c. which before were unavoidably in daily use, to the great terror of the men.

The sensations produced in the minds of the men by so desirable an alteration will be productive of the most beneficial consequences to the mining business, as it is now prosecuted with pleasure and success; and we at once acknowledge our obligations to Lord Viscount Dudley and Ward, the Honorable Washington Shirley, the Rev.

Joseph Cartwright, and Samuel Fereday, Esq. for patronizing so invaluable a discovery; and congratulate our fellow-labourers on the prospect of security from such terrible destruction.

WILLIAM TURNER, his mark ⋈,
Charter Master at No. 2.
JOSEPH HATELY, his mark ⋈,
JOSEPH MANSEL, his mark ⋈,
Charter Masters at No. 3.
SAMUEL SOUTHAL, his mark ⋈,
THOMAS SOUTHAL,
Charter Masters at No. 4.

(Witness) JOSEPH FEREDAY.

Buffery Colliery, Dec. 1, 1809.

CERTIFICATE, No. 2.

The numerous lives lost in Lord Viscount Dudley and Ward's Collieries by inflammable gas, and the excuses made use of to account for it, left no doubt in our minds as to the fallacy of the system acted upon. Mr. Ryan being employed in 1808 to ventilate the dangerous works, he succeeded beyond our most sanguine expectations, without recourse to the former expedients, which were both expensive and dangerous: being employed to open new works, he never suffered them to accumulate gas; which made the agents say that it arose from natural causes. To convince them, Mr. Shirley allowed him (Mr. Ryan) to withdraw his system: in two days the agents reported the works to be so infested with gas, that it would be impossible for Mr. R. or any one else to free it, without recourse to the former expensive system, which would take some months to execute. Mr. Ryan then engaged to clear the works in *six hours*, and risk his life in the performance of it; which was executed on the 12th of June, to the entire satisfaction of Messrs. Fereday and Smith, who attended to inspect this trial. Mr. Ryan's system is not affected by

the weather, and appears well calculated to guard against incendiaries. On the occasion before mentioned, the agents of Lord Dudley and Ward privately stopped up the air-courses; which had it been done on the old system, must inevitably have been attended with death. We have no hesitation in saying, that during a course of experiments for two years and a half, in the most dangerous works, without firing-line or any other expensive precaution, he did not lose one life, neither was any one rendered incapable of labour; and the effects of his operations are still visible and evident in the works.

W. SHIRLEY.
SAMUEL FEREDAY.

London, April 26, 1811.

CERTIFICATE, No. 3.

Joseph Hately, Charter Master at the No. 3, Buffery Colliery, will, upon oath, if required, prove that his pit was the only one the gentlemen from Newcastle went into at the Buffery, and they put the following question to him:—

Was you troubled with fire before Mr. Ryan was employed?—I answered, that we used the firing-lines regularly before, and have not used them since; that the method used by Mr. Ryan was not in practice to my knowledge before Mr. Ryan introduced it; and that we are not in fear or danger of fire at the present time; that my employers, Mr. Jones and Mr. Joseph Fereday, directed me to take them into the pit, and to tell them the truth.

The signature of JOSEPH HATELY.

MICHAEL BILL, Witness to the signing.

Buffery Colliery, 3d February, 1815.

CERTIFICATE, No. 4.

SIR, *Percy Street, Newcastle, Nov.* 5, 1815.

In compliance with your request, I have no hesitation in repeating what I stated to the first meeting at the Assembly Rooms; that having in June last had some conversation

with Mr. Baddaley, of Dudley, on the accidents which have lately happened in this neighbourhood, and having asked in my turn respecting the accidents in the Dudley coal-mines, I certainly understood him to say that they had been much fewer, from the explosion of inflammable air, since a person of the name of Ryan had been in that neighbourhood.

I am, Sir, &c.

WM. TURNER.

To Mr. James Ryan.

CERTIFICATE, No. 5.

From the Tyne Mercury, 12th September 1815.

At a meeting holden on the 9th of September at the Assembly Rooms, in Newcastle-on-Tyne:

Resolved—That Mr. Ryan having submitted to us his plan of ventilating mines, we do highly approve of it, as consistent with the principles of philosophy; and that we recommend it to be taken into consideration by persons interested in the Coal-mines.

R. W. GRAY,	CHRIST. BENSON,
WM. TURNER,	WM. CLARK,
J. H. BIGGE,	WM. ARMSTRONG,
N. JOHN WINCH,	DIXON BROWN,
J. CARR,	R. W. BRANDLING,
JOHN HODGSON,	ANTHONY CLAPHAM.

CERTIFICATE, No. 6.

Walker's Hotel, Bridge Street, Blackfriars,

DEAR SIR, *May* 2, 1816.

I was from home this morning when you called, which was rather a disappointment to me: however, I answer your Letter with great pleasure.

Certainly, I do recollect when you were at Buffery Colliery; and but for your plans, though I cannot say I am fully acquainted with them, but I now repeat from my

father's ideas of ventilation, I do believe there would have been a great many more lives lost than there has been of late. And when I recollect the time you, with many others, ventured down one of the pits at Buffery Colliery, which had been for some time stopped up, and cleared it of the inflammable gas, I must own I was quite surprised.

When the explosion took place at Mansell's pit, I recollect it was the opinion of every one present, that all the men then down were certainly lost;—but, to my great astonishment, not one was hurt.

I remain, Dear Sir, Yours, &c. &c.

DUDLEY FEREDAY.

To Mr. James Ryan, &c.

XX.—*The History and Treatment of Bony Tumours.* *By* WILLIAM GIBSON, M.D.—(Continued from p.75.)

WITH A PLATE.

VERY considerable ossified depositions are found, occasionally, upon different parts of the vertebral column. In some instances, bony flakes supply the place of the ligament covering the intervertebral substance: in others, the intervertebral substance itself is converted into bone, rendering the spine a solid inflexible mass. I have seen a preparation, exhibiting the complete union of every vertebræ of the body, and constituting a solid pillar of bone from the head to the sacrum. In my collection, there are two specimens of several dorsal and lumbar vertebræ completely united by bone, instead of ligament; and the Wistar Museum contains a most beautiful preparation of caries in the bodies of ten dorsal vertebræ, with destruction of the intervening cartilages, where a splint half an inch thick and twelve inches long, covered with protuberances, has been thrown out on the anterior and right side of the spongy bodies, uniting them closely to each other, preventing deformity and effecting a cure by firmly supporting the whole spine. Part of the spine of a horse belongs to the same

collection, having the bodies of the dorsal vertebræ strengthened in a similar manner, by a bony splint, still more extensive. Freke has recorded the case of a boy whose back and ribs were covered with bony projections, from the neck to the sacrum. "April 14th, 1736," says he, "there came a boy of a healthy look, and about fourteen years of age, to ask us at the hospital, what should be done to cure him of many large swellings on his back, which began about three years since, and have continued to grow as large on many parts as a penny-loaf, particularly on the left side. They arise from all the vertebræ of the neck, and reach down to the os sacrum: they likewise arise from every rib of his body; and joining together in all parts of his back, as the ramifications of coral do, they make, as it were, a fixed bony pair of bodice*."

All the bones of the pelvis are more or less subject to exostosis. The ilia, ischia, pubes, and acetabula of a pelvis in the Wistar Museum, are studded with tuberculated exostoses. They are particularly large and conspicuous at the superior and inferior spinous processes of the ilium, and on each side of the outer surface of the pubis, over which thick bony masses, an inch long, project and unite with each other in a vaulted form, at the symphysis. Several bony plates, resembling the heads of large nails, are fixed upon each sacro-iliac junction, apparently serving the purpose of connecting the iliac bones firmly with the sacrum.—An exostosis upon the inside of the pubis has occasioned death, by compressing the neck of the bladder, and preventing the introduction of the catheter†.—The *uterus* has been ruptured by an exostosis, seated behind the pubis. A case of this kind occurred, several years ago, in the practice of Dr. Dewees‡. The patient died; and upon examination by Drs. Physick and Dewees, "the pelvis was found faulty at the superior part, by a *projec-*

* Philosophical Transactions, vol. ii. p. 252.
† See Boyer on the Bones, vol. i. p. 354.
‡ Coxe's Museum, vol. ii. p. 411.

tion of bone or an exostosis: it was situated a little to the left of the symphysis pubis, and looked towards the base of the sacrum: it diminished the superior cavity of the pelvis, in the direction of its small diameter, about half an inch: it was sharp and pointed at its extremity. The projection of the bony process just mentioned, by diminishing the cavity of the pelvis, must be regarded as the remote cause of this accident. The child's head, enveloped in a portion of the uterus, rested against this point so long, that inflammation and gangrene were the consequence. The efforts of the uterus continuing violent, and perhaps that violence increased by the difficulties which opposed them, eventually gave way, as its substance at this particular part was much weakened by the changes produced on it by inflammation; nay, the bony tumour acted somewhat like a cutting instrument."—Although I am unacquainted with a case of the kind, it is easy to conceive that an exostosis occupying the cavity of the pelvis, even when it does not attain considerable bulk, may present great difficulties to the passage of the child during parturition. Portal seems to have entertained the same view, when he says, "Indépendamment des vices du bassin provenant de sa conformation vicieuse, sa cavité en général et ses deux détroits en particulier pourroient être rétrécis par des exostoses plus ou moins grosses; il peut aussi se former des tumeurs de diverse nature dans le bassin même, dans la matrice ou dans les parties molles adjacentes, qui empêchent la sortie de l'enfant de cette cavité *." Sarcomatous and encysted tumours within the pelvis are by no means uncommon; and have proved so injurious, by interrupting delivery, that out of eighteen cases recorded by different writers, it appears, one half of the patients died, and the greater part of the rest recovered imperfectly†.

Exostosis may occupy any portion of the thigh-bone, but is seldom found either at its head or condyles. Every

* Cours d'Anatomie Médicinale, tom. i. p. 374.

† See Merriman's Cases of Tumours within the Pelvis, in Medico-Chirurg. Transact. vol. x. p. 50.

variety of the disease is occasionally produced. A femur in my possession is studded at different points, chiefly on the posterior surface, with numerous tuberculated exostoses of considerable size. There is, also, upon the same bone a circumscribed exostosis, four inches long; commencing below the great trochanter, and bulging an inch beyond the shaft of the bone.—A very fine specimen of lamellated exostosis is contained in the Wistar Museum. The femur is of extraordinary thickness (measuring in circumference eleven inches), uncommonly heavy, and covered with immense scales or osseous incrustations folded across each other, and irregularly plaited like the skin of a rhinoceros. These masses extend from the trochanter to the condyles, and in some places are upwards of two inches long. The head and neck of the femur and condyles are of the natural size, and free from disease. (Plate X. fig. 2.) Thirteen examples of exostosis of the femur are given by Daubenton*, in three of which the whole circumference of the bone is enlarged to the extent of nine and a half inches. —The work of Sandifort contains several tuberculated and circumscribed exostoses. Upon one bone, a smooth tumour, four inches long, two thick, and shaped like a kidney, rises, by a broad base, from the inner side of the thigh-bone, near the lesser trochanter. In another specimen, an exostosis of the same kind extends beyond seven inches; and in several others the tuberculated variety is distinctly marked†. Mr. Howship‡ mentions an exostosis, belonging to the collection at St. Bartholomew's Hospital, of such astonishing magnitude as nearly to equal three feet in circumference, and conceal the whole length of the femur. The spinous exostosis is rarely met with on the femur; at least I know of three examples only—two in the Wistar Cabinet, and one described and delineated by Sir A. Cooper. In the former, each thigh-bone, just above the

* Description du Cabinet du Roi, tom. iii. p. 87.
† Museum Anatomicum, vol. ii.
‡ Medico-Chirurg. Transact. vol. viii. p. 97.

condyles, is irregularly enlarged, twice beyond its natural size; and from this protuberance several bony spires project. The longest grow from the inner side, run upwards and parallel with the shaft of the bone. (Plate X. fig. 3.) In the case detailed by Sir A.Cooper, an exostosis, from one to three inches long, occupied the thigh-bone above the internal condyle, and was felt, through the integuments and muscles, about the size of the finger. When the patient walked, he felt what he described as a snapping in the part, like a cord slipping from a pulley; which probably arose from the extension of the sartorious muscle, and its sudden slipping over the swelling. When he placed the limb quite straight, he found a difficulty in bending it; and when bent, it was almost equally difficult to extend it: each flexion and extension producing a snapping noise, which could be distinctly heard*.

The tibia is extremely subject to exostosis. Among several specimens in the Wistar Cabinet, four particularly deserve notice. In the first, the bone is enlarged irregularly from the tubercle to the middle of the leg, three times beyond its natural size. The fibula also is increased in the same proportion, and anchylosed with the tibia.—In the second, a circumscribed exostosis, the size of an egg, springs both from the tibia and fibula, about two inches above the ancle, firmly uniting, and at the same time forcing these bones out of their natural position.—In the third, the superior and inferior extremities of the tibia and fibula are enlarged and anchylosed: the fibula especially, including two thirds of its superior extremity, is covered with very rough processes, and the bone nearly equals in size the tibia itself. In the fourth specimen, numerous spinous exostoses arise from each extremity of the tibia. Those attached to the upper end of the bone run downwards; while those seated near the ancle extend upwards, nearly in a line with the tibia. Each extremity of the

* Surgical Essays, p. 219.

tibia is enlarged, as in the specimens of the same disease in the femur and humerus already described. (Plate X. fig. 4.) Many examples of exostosis of the tibia are found in different authors. Chesselden* has given a very fine engraving of a circumscribed exostosis, seated on the upper end of the tibia,—equal in size to a child's head. Sixteen specimens, varying in shape and size, are described by Daubenton†. The Museum of Mr. Charles Bell, of London, contains numerous specimens of the same kind‡. Several of the inferior animals are subject to exostosis of the tibia and metatarsal bones. The diseases called *splent* and *spavin*, so common among horses, are of this description. In my collection are two very beautiful preparations of the knee-joint of the horse affected with spavin; in which bony matter has been thrown out profusely, so as to resemble the tuberculated exostosis in the human subject.

The upper and lower extremities of the fibula are more subject to exostosis than the intermediate portions. A fibula belonging to the Wistar Museum is represented in Plate X. fig. 5., upon the upper end of which an irregular exostosis, as large as an egg, is seated. Each end of the fibula, belonging to the opposite leg, terminates in a bulb of considerable magnitude. In two fibulæ in my possession, irregular exostoses cover the greater part of the bone, rendering each nearly as large as the tibia.

I have never seen true exostosis either of the tarsal or metatarsal bones, and believe the disease to be equally uncommon in the toes. Two exostoses, projecting from under the nail of the great toe, are mentioned by Sir A. Cooper, who removed one with a saw, on account of the pain it occasioned the patient. The same writer states, that he has known half the foot amputated, on account of exostosis, at the extremities of the metatarsal bones next the toes.

* Osteographia, Plate LIII. p. 53.
† Histoire Naturelle du Cabinet du Roi, p. 93.
‡ Description of the Anatomical Museum of the School of Great Windmill Street, 4to. p. 7.

TREATMENT OF EXOSTOSIS.

In every true exostosis, or simple enlargement from inordinate deposition of ossific matter, much may be done both by constitutional and local means. General remedies, especially when combined with rigid abstinence, exert a more powerful influence over local diseases than is commonly imagined. There is scarcely a tumour, however large or extensively involved, whether situated among vital parts or confined to the common textures of the body, which may not, by judicious management, be made to feel the operations of the absorbent system. By abstracting from the body its accustomed nutriment, the proportion to particular parts is diminished, and regular demands are then made upon all those textures which act subserviently in the animal economy. Superfluous fat is removed from its cells, and made to contribute to the support of the general system. In like manner, unnatural enlargements and morbid superstructures are changed or extinguished, and forced to renovate the waste which is perpetually taking place. A knowledge of these powers leads, in the hands of judicious practitioners, to very important results—such as are too often overlooked. The active aid of operative surgery, instead of being regarded with horror and as an exercise of skill often ostentatious and unnecessary, is frequently employed before general remedies are even tried, and resorted to under circumstances where benefit cannot be expected to result. Whoever attends an European Infirmary will be struck with the diversity and multiplicity of operations, performed upon the most trivial occasions. Will it be credited when I say, that the illustrious founder of American Surgery, during a practice, both hospital and private, of thirty years, and more extended than that of any other individual of our country, has hardly ever had occasion to resort to amputation? It may be asked, What became of his patients? I answer, they have been cured by general and local means. 'Doctor,' said a late surgeon of the Pennsylvania Hospital, to a distinguished practi-

tioner of a neighbouring city, what would be done in your town with such a leg?' 'We should cut it off,' was the reply. 'We can *cure* it *here* without,' rejoined the other.—"In a certain London Hospital," says Dr. Gregory, "a patient was under the care of the physicians, on account of a very bad leg, which baffled their skill, and appeared to them almost hopeless; they therefore requested a consultation of the surgeons, to examine the leg, and to decide what should be done with it. The surgeons accordingly met, examined it, consulted about it, and resolved, *nemine contradicente*, that the leg could not be saved, and ought to be cut off. They cut it off without delay. But, strange to tell! the physicians, at their next visit, on examining the patient, found, to their great astonishment, the supposed hopeless leg as fast to his body as ever it had been. The puzzle was soon explained. It happened that the man had *two* legs, both of them very bad: one of them the physicians thought they could save, the other they despaired of. There being but a right and a wrong, it was not very marvellous that the consultation took the wrong. Both physicians and surgeons, I believe, were a little disconcerted at that *quid pro quo*; and as it was thought rather a strong measure to cut off both the man's legs, they exerted themselves to the utmost, and saved the leg which should have been cut off: so that, after all, the poor man was but one leg out of pocket. As I was not an eye-witness of this edifying transaction, it is proper to give some notion of the genealogy of the story, which is very short and simple. I have it from a reverend clergyman, who had it from one of the physicians concerned, and who is now one of the most eminent of his profession in London. I know both the clergyman and the physician intimately; I know them both to be men of veracity and men of sense; and I have no doubt that the facts were just as I have stated them *." These remarks may appear, perhaps, irrelative; but I am satisfied of their importance, and shall be gratified if they

* Additional Memorial to the Managers of the Royal Infirmary, p. 265.

tend to check the disposition, so prevalent among young surgeons, to use the knife; or contribute in a single instance to alleviate pain, or remove disease by milder or more appropriate means.

Wherever an exostosis be situated, provided it is painful, grows rapidly, presses on some important organ, impedes the motion of a joint, or interferes with the flexion or extension of a limb, it will become expedient to interrupt its progress or remove it entirely. For this purpose we commence by gradually abstracting from the patient his accustomed quantity of aliment; by prohibiting nutritive articles, whether solid or fluid; by obliging him to avoid spirituous, fermented, or stimulating liquors of every description; and by restricting him to diet in every respect adapted to his age, constitution, and habits. It is impossible to lay down precise rules applicable to every case, since almost every individual is liable to have the natural actions of his body disturbed by causes which have no influence over the system of another. Many patients can live, for weeks or months, on a little tea and a few crackers a-day, without being as much debilitated as others who are allowed animal food and more nutritive drinks. Much therefore will depend upon the peculiar constitution of the patient; and this may generally be ascertained in a short time. It is a great mistake to suppose that old people cannot bear a system of abstinence, or that debility is necessarily associated with age. There are many persons extremely vigorous in advanced life, who can sustain, with impunity, deprivations sufficient to destroy younger and more delicate patients. It is true, however, that the systems of most old people sooner and more suddenly suffer from diminution of accustomed food, than those of younger ones. For this we should be prepared, and ready to substitute nourishment, so soon as we perceive the system suddenly yield. By pursuing this plan steadily and for a length of time, we shall often succeed in removing exostosis and other tumours of considerable magnitude, without the employment of other means; but, in general, it will be

necessary to administer purgatives every third or fourth day, or at stated periods, and to draw blood either from the system or locally. Local blood-letting, if the tumour be inflamed or painful, will prove extremely serviceable. Leeches should be preferred to cupping, and ten or twenty will be sufficient to detract several ounces of blood. They should not be applied over the most prominent or inflamed part of the tumour, lest ulceration follow their bites.—Besides these remedies, pressure, gradually and steadily applied, will act powerfully, in promoting absorption. When the exostosis is seated upon the extremities, a firm compress, supported by a roller, will answer every purpose; but in certain situations, as on the cheek-bones, it will be necessary to use a species of truss, or an elastic spring, so constructed as to keep up moderate but constant pressure. Some tumours, however, will not bear even the slightest pressure; and if the patient is resolute enough to endure the pain, ulceration will be apt to follow—with increase of the disease. Sometimes pressure with adhesive straps, covered with sheet lead and a roller, answers a useful purpose.

Blisters, kept open by savin cerate, have been extolled by some writers as efficacious in exostosis; but I have tried them in two or three instances, without effect. In venereal exostosis, or node, they are sometimes beneficial.

When these remedies fail, and the exostosis continues to increase, becomes more painful, interferes with some important organ, or endangers the patient's life, an operation may, perhaps, be necessary. It cannot, however, always be done. Anatomical considerations will sometimes prohibit it: at other times, owing to the duration and size of the tumour, so much irritation would be produced as either to destroy the patient, or render the cure very tedious or doubtful. If the tumour is not very large, is of the circumscribed, tuberculated, or spinous varieties, and situated superficially, such incisions should be made as to expose its base to the action of Hey's saw, or the trephine. By the conjoint operation of these instruments, I removed, several years ago, from the tibia of a boy, in the Baltimore

Hospital, a circumscribed exostosis of considerable magnitude, which had resisted every other remedy. About the same period, I removed with success, and by similar means, a large exostosis from the outer condyle of the humerus, of a young gentleman, a patient of Dr. Allender, of Fell's Point. But often the exostosis is so situated, that neither the trephine nor Hey's saw can act without injuring, materially, the surrounding soft parts.

To obviate this inconvenience, several cutting instruments, within a few years, have been invented. Mr. Machell*, an English surgeon, has constructed a circular saw, calculated to work beyond its semidiameter, and at a considerable depth, without interfering with the muscles. The saw is actuated by several wheels, inclosed in a case or conveyance, which are propelled by a winch or windlass. A pair of forceps is attached to the instrument, in order to fix it to the bone, and keep it steady while the saw is in motion. Having never seen this instrument, I cannot speak of it from experience; but, if a proper estimate can be formed from the drawing and description, it would appear exceedingly complicated and expensive, and not calculated to answer, without great trouble, the purposes for which it was designed. The teeth of the saw, moreover, being placed on wheel-teeth or cogs, which work upon each other, must necessarily be injured or broken after a few revolutions. Again—unless the forceps be screwed with great force, so as to take a very firm hold of the bone, the saw cannot be made to work steadily, and more or less resiliency must follow every attempt to set it in motion. Both hands of the surgeon being employed, one in moving the handle, the other in holding the conveyance, it will appear evident, that, without the aid of the forceps, the instrument, if it can operate at all, must do so under every disadvantage. It was on this account, perhaps, that Sir A. Cooper failed in removing an exostosis from the

* Edinburgh Medical and Surgical Journal, vol. xi. p. 273.

femur, with this machine, until he secured it by the forceps. "The saw was then attempted to be used," says he, "without the forceps; but it could not be well fixed: the forceps was, therefore, added to it, and the bone was sawn through." But there are many situations where the forceps cannot be applied, or, if applied, cannot render the saw steady.—The circular saw of Mr. Griffith*, although extremely simple in construction, possesses so little power as to render it unfit for the most common purposes, and is decidedly inferior to that of Hey.—The chain-saw of Dr. Jeffray†, of Glasgow, appears to me calculated for no other purpose than that for which it was originally designed—the removal of carious joints; but, under any circumstances, it is extremely liable to twist or break; as I have several times proved, in operations upon the dead subject. The cutting plyers of Griffith and Liston are fit only to detach small spicula of bone, or to remove loose carious portions‡.—To overcome difficulties insurmountable with Hey's saw, the trephine, &c., I suggested to Mr. Adam Stewart (an ingenious mechanician of this city) the idea of constructing an instrument calculated to work at considerable depth, without injuring the soft parts, and propelled by a spring of sufficient strength to create several hundred revolutions of a circular saw within a few seconds. The sketch (Plate VIII. fig. 3) represents a machine of this description, exceedingly simple, yet so powerful as to divide, with the utmost celerity, the hardest bone or ivory; making a cut proportioned to the size of the saw, and the pressure with which it is applied to the part. The superior extremity or expanded portion of the instrument incloses, in a brass frame, a strong clock-spring, attached to a wheel; and from this, a connecting rod extends to the pinion of the saw, and gives it motion. The spring is wound up by a winch, and restrained by a catch,

* Surgical Essays, p. 218.
† Jeffray's Observations on the Excisions of Carious Joints, p. 175.
‡ See Edinburgh Journal, No. lxvi. January 1821, p. 155.

until the operator wishes to set it free; which he does by slight pressure with his thumb or finger on the catch. The instrument may be held in the hand, like a writing-pen, and the saw directed to any part we desire to cut; its velocity being regulated, or its movement instantly stopped, if necessary, by the catch. Several saws, of different sizes, are adapted to an axle, placed at right angles with the shaft of the instrument, and by means of a small spring can be instantly changed. The axles also, are of different lengths, so as to extend into the deepest wound, or to work near the surface, as may be required. To prevent the saw from being stopped at its semidiameter, cutting-edges or teeth are given to the axle, which enable it to make its way through the bone, so as to divide it perpendicularly, while the saw itself moves in a horizontal direction. By this contrivance very large exostoses may be removed at once, or by repeated applications of the instrument, which could not be reached in any other way. Although I have yet had no opportunity of trying this saw on the living subject, I have made so many experiments with it on the dead, as to be perfectly convinced of its power and utility. It is adapted to many purposes besides the removal of exostosis; and is admirably calculated for splitting a bone, to any extent; cutting out a portion of it; and removing sequestra, in cases of necrosis, &c. In such cases, a plain axle, instead of a toothed, should be used. The only case in which I should hesitate to employ it, would be on a fractured skull: in exostosis of the cranium, however, it may be employed with as much safety as any other instrument. In case of necessity, a forceps may be adapted to the instrument, and the spring rendered quiescent; so as to obtain, by the use of the handle, the exact principle (but in greater perfection) of Machell's saw*.

* Professor Gibson confesses, that he is not acquainted with the construction of Machell's annular saw; neither does he give such an ample account of the internal mechanism, by which his own circular saw is actuated, as would enable an instrument-maker to construct it. In our next Number we shall endeavour to afford our Readers the information necessary to render both these saws *self-acting*.—EDITOR.

Sir A. Cooper has given the history of five operations for the removal of exostosis.—The first was of large size, and formed like an inverted pyramid, the apex of which was attached to the tibia: it had been growing forty-four years. An elliptic incision was made through the integuments, and the tumour removed by the amputating saw, without much difficulty.—In the second case, a spinous exostosis was taken from near the inner condyle of the thigh-bone of a young lady, eleven years old. The limb had been painful as low as the heel; and when the patient "attempted to run, she felt a snap upon the swelling, as if a cord had slipped out of its pulley, which was owing to the tendon gliding over the projecting part of the bone." The tumour was separated by Machell's saw, and the irregularities that remained smoothed by the bone-nippers.—The circumstances of the third case were nearly similar to those just detailed.—In the fourth case, an exostosis of the fibula, involving the fibular nerve, thereby producing paralysis of the peroneal muscles, as well as the flexors of the foot and extensors of the toes; was removed by Hey's saw.—In the fifth case, a large exostosis, growing from the outer and left side of the pubis, attended with great pain in the hip, above and below the knee, and in the foot, was separated by Machell's and Hay's saws.—These patients were all cured, except the fourth, who was relieved of pain, but not of the paralysis.

In 1815, a gentleman, from the eastern shore of Maryland applied to me on account of a circumscribed exostosis, which occupied the middle of the os frontis, had been growing for years, arose without evident cause, attained the size of a large egg, and was solid and incompreliensible. Ulceration possessed the most prominent part of the tumour, which was supposed by the patient to be cancerous. As various remedies had long been tried, ineffectually, an operation appeared to furnish the only prospect of relief. An incision, traversing the whole swelling, was made, and the integuments turned aside, so as to expose the base of the exostosis, which was then removed, with difficulty,

by Hey's saws. The substance was reticulated, and did not differ, apparently, from that of sound bone. The internal table of the skull remained entire, the patient recovered in four weeks, and the complaint has never returned.

An exostosis may be removed from almost any bone of the body; provided it does not embrace its whole circumference, or extend throughout its length; as in the lamellated exostosis represented in Plate X. fig. 2.—When a very large bony tumour surrounds the arm, fore-arm, thigh, or leg, and an operation becomes necessary, nothing less than amputation will probably answer.—There are certain situations, where it would be difficult, if not impossible, to remove even a circumscribed exostosis occupying part of a bone. Thus, such a tumour growing from the inside of the pubis or sacrum, interrupting the flow of urine, or impeding the passage of the child in parturition, could not, perhaps, be reached or extracted. In the latter case, however, so much danger, probably, would not result; as an experienced accoucheur would attempt to turn the child, and avoid the projection.—The removal of an exostosis, arising from the inner surface of the ribs, as in the case related by Giffard, to which I have already referred, would be attended with great difficulties. The same may be said of the disease when seated on the spine; except the spinous processes alone should be involved; in which case an operation might be very beneficial; as shall be shewn hereafter, when I speak of an osteo-sarcomatous tumour, of monstrous size, which I removed, in October, 1818, from the spine of a young gentleman in Maryland.—An exostosis, growing from the inner table of the skull, and pressing upon the brain, might perhaps be removed; but not with much prospect of success. This would arise less from the difficulty of the operation itself, than from the exposure and subsequent inflammation of the brain and its membranes. Cases may possibly present, however, where the surgeon would be justified in resorting to an operation; as in the

examples recorded by Howship* and Wadd†, of ossific matter deposited between the tables of the skull, distorting the bones, and producing insanity by presure on the brain. The successful issue of the interesting operation by Keate‡—the removal of a bony tumour, involving the lamellæ of the greater part of the os frontis, and containing an enormous collection of hydatids, should form an additional inducement to saw away any bony mass encroaching upon, or interfering with, the functions of the brain.—An exostosis of the lower jaw, involving its circumference, might possibly be removed, by cutting through the bone, on each side of the tumour, and completely insulating it. The void would afterwards be filled by callus; or the cut extremities of the bone so firmly united by ligamentous substance, as to render the jaw nearly as useful as ever. Again—if the tumour should be situated at the symphysis, the jaw could readily be cut through on each side of it, and the ends of the bone pressed together and united, as in Dupuytren's celebrated operation for artificial chin§. Great deformity, however, must necessarily result from such a proceeding; and, in many instances, I think the operation would be totally unnecessary, and should be supplied by the following mode, which I adopted, three or four years ago, in a case at the Baltimore Alms-House. A poor woman had a tumour, partly fungous, partly bony, the size of a large orange, which sprang from the symphysis of the lower jaw, on the inner side, pushed before it several teeth, and so filled the mouth, as nearly to prevent swallowing, and render articulation almost unintelligible. In presence of Drs. Caldwell, Bell, Hayden, and others, I divided, with a strong curved knife, the alveolar processes (softened by caries) on each side of the symphysis, nearly to the base of the jaw, separated the

* Medico-Chirurgical Transactions, vol. viii.
† Malformation, and Diseases of the Head, by Wm. Wadd, 4to. 1819.
‡ Med.-Chir. Trans. vol. x.
§ See Dict. des Sciences Médicales, tom. xxix. p. 430.

tumour from its attachments, and controlled the hemorrhage by ligatures and the actual cautery. Upon examining the cavity, or bed, occupied by the tumour, I was surprised to find how much of the jaw had been absorbed—a small portion only of its base remaining on each side of the symphysis. Great as the vacuum was, however, it was soon filled by granulations and ossific depositions; and, in a few weeks, the patient entirely recovered. Nothing could have been easier, in this case, than to have imitated Dupuytren, by cutting away the base of the jaw, and bringing together its ends: but, if I had done so, the patient would not only have been horribly disfigured, but mastication and speech greatly injured, by the teeth and tongue being thrown from their natural situation.

Should an exostosis occupy the orbit, and displace the eye, it may be removed, provided the base be not very large; not by following the practice of Lucas *—cutting down upon the tumour, and then leaving it to drop off by caries—but applying cautiously Hey's, or a small circular saw, as near to its base as possible. If the tumour cannot be reached by a saw, it may, perhaps, be made to exfoliate by the application of acids or caustics. An interesting case illustrative of the beneficial effects of caustic, is related by Louis †. A woman, thirty years of age, suffered from a fistula lacrymalis, which resisted every remedy. The bones became enlarged; and an exostosis, the size of an egg, occupied the os planum and internal angular process of the os frontis. The eye was forced from its socket, and hung over the cheek. Brassant, the surgeon who attended the patient, applied caustic to the exostosis; suppuration followed; and in three or four months the greater part of the tumour exfoliated, the eye resumed its position, and a cure was soon completed. Neither the saw nor caustic, however, will often be required for exostosis of the orbit, as the disease must be considered rare. Tumours of a different

* See p. 125.

† Mémoires de l'Académie de Chirurg. tome xiii. p. 277.

description—steatomatous, encysted, and sarcomatous, frequently occur, and become so large as to displace the eye. Several such cases I have seen. I know a gentleman at the present time, whose eye is pushed to one side, and almost squeezed from the socket, by an encysted tumour, which could be removed, with success, and with the utmost facility. In the year 1818, I took from the orbit of a patient, under care of Dr. Coulter of Baltimore, a sarcomatous tumour, which grew from the socket, compressed the eye, and in time would have destroyed it. Similar examples are related by Trincavelli, Paau, Astruc, Bertrandi, Bonetus, Louis, Le Dran, St. Ives, Hope, Brocklesby, Rodman*, &c.

There is another operation for the removal of exostosis, which deserves to be tried, whenever the situation of the disease will admit of it, before we resort to extirpation with the saw, or to amputation of a limb. This consists in the separation of the periosteum from the tumour; thereby, in a measure, depriving the part of vascularity, and promoting its absorption. The remedy was proposed some time since by Sir Astley Cooper, and communicated to me in a a Letter by Mr. Charles Bell of London. "Sir A. Cooper told me," says Mr. Bell, "last night, at the Anatomical Society, that he finds the largest tumours of exostosis absorbed by simply cutting down upon them, and separating the periosteum from the face of the bone by the handle of the knife." I have not had an opportunity to test this practice, and therefore cannot speak from experience; but I am inclined to believe that it will not answer the high expectations we should naturally form from the commendation of so distinguished a surgeon as Sir A. Cooper. I am induced to draw this conclusion, from knowing that the older surgeons were in the habit of performing the same operation, in cases of venereal exostosis, or node, some-

* See Schenkius—Mémoires de l'Académie—Sepulchretum Anatomicum—Maladies des Yeux—Philosophical Transactions, 1744—Medical and Physical Journal—London Med. Obs. and Enq.

times with success, but frequently without any benefit whatever.

Of the venereal exostosis I might next speak; but as the disease differs essentially from common exostosis, and requires a distinct mode of treatment, it should be considered under a separate head. In a subsequent number of the Journal, I propose to make some observations on osteosarcoma and spina ventosa, diseases often confounded with exostosis, but in reality bearing to it only a remote resemblance.

XXI.—*On Improvements in Setting Razors and other Cutting Instruments. By* GEORGE REVELEY, *Esq. In a Letter to* Arthur Aikin, *Esq. Secretary to the Society of Arts, &c. &c.**

Queen-square, Bloomsbury, January 8th, 1821.

SIR,

I BEG to communicate to the Society of Arts, for the benefit of the public, a new method of setting razors, by substituting soap instead of oil. Not having any oil to set my razor, it occurred to me to try the soap I was washing with, called palm-soap; and I found it so completely to answer my purpose, that I have constantly used it ever since, instead of oil, both for razors and penknives. It sets quicker, gives a good edge, and removes notches with great facility: it is a more cleanly material, oil being liable to drop on and soil any thing it comes in contact with: dust will frequently get into oil, which will spoil the edge, and in such case it must be changed. It is as cheap or cheaper than oil; a small square of palm-soap costing only threepence, which will last for a great length of time. The operation is performed as follows: Having first cleaned your hone with a sponge, soap, and water; wipe it dry; then dip the soap in some clean soft water; and, wetting also the hone, rub the square of soap lightly over it, until the surface is thinly covered all over: then proceed to set

* From Vol. XXXIX. of the Transactions of the Society.

in the usual way, keeping the soap sufficiently moist, and adding from time to time a little more soap and water, if it should be necessary. Observe the soap is clean and free from dust, before you rub it on the hone; if it should not be so, it is easily washed clean: strop the razor after setting, and also again when you put it by, and sponge the hone when you have done with it.

I am, Sir, &c. &c. &c.

A. Aikin, Esq.
Secretary, &c. &c.

GEO. REVELEY.

Queen-square, Bloomsbury,
February 9th, 1821.

SIR,

I herewith send Certificates respecting my method of setting razors, which also include workmen's tools. The fact thereby established, of setting quicker, is important; as one-fourth in time gained by those who are employed in setting a considerable number of razors, &c. is an object both as to convenience and in saving expense: the excellent state in which it keeps the hone, is also an object, both in respect to cleanliness, and the advantage of its surface being kept in a better state for action than when oil is used. With respect to novelty, I only can say I never heard of any one having used it, or received any information from any one on the subject of setting with soap, previously to my making the communication to the Society; nor can I learn, on inquiry, that it is known to the public. You will have the goodness to communicate the contents of this Letter, and also of the Certificates, to the Chairman and the Gentlemen of the Committee of Mechanics.

I am, Sir, &c. &c. &c.

A. Aikin, Esq.
Secretary, &c. &c.

GEO. REVELEY.

CERTIFICATES.

SIR,

9, Boswell-Court, Queen-Square.

I have tried Mr. Reveley's discovery, and am of opinion that the use of soap for the setting of razors is preferable to

that of oil, because they are set quicker, and I think much better; besides, the operation of setting may be performed with a greater degree of cleanliness.

I have set the razors in the following manner: those marked × are set with palm-soap, those marked \ with common soap, and those marked // with oil.

WM. WEST,
Razor-maker, and Working-cutler.

A. Aikin, Esq.
Secretary, &c. &c.

SIR, *Poultry, Febuary 22d*, 1821.

After repeated trials of Mr. Reveley's method of setting razors with soap and water, instead of oil, upon the hone, I am of opinion, that it is much more cleanly, and quicker in producing the required edge, and certainly better calculated for the travelling case of an Amateur of that useful art.

I am, Sir, &c. &c. &c.

W. H. PEPYS.

A. Aikin, Esq.
Secretary, &c. &c.

GENTLEMEN, 217, *Holborn, Feb. 23d*, 1821.

Being an invalid, prevents me the honour of attending your Committee this evening, on the subject of Mr. Reveley's employment of soap, instead of oil, for setting razors, &c.

After having made repeated trials of this new mode of setting razors, I am in candour bound to give it my support: for many purposes it is equal, and in some I think it is superior, to the finest oil commonly used for setting cutlery, and edge-tools in general.

I am, Gentlemen, &c. &c. &c.

RICHARD LONG.

55, *Southampton-Row*,
SIR, *Feb. 8th*, 1821.

For the convenience and advantage which I derive from your kind communication, as to the use of soap in lieu of oil, I beg you will be pleased to accept my sincere thanks. I have almost daily some fresh instance of its utility. My

workmen assure me, that in setting their tools, they can do it both quicker and better than with oil.

In point of cleanliness, there is certainly no comparison between the one and the other. Until you kindly informed me of this use of soap, our oil-stone had been a continual nuisance, perpetually daubing and injuring one article or another; but, by the adoption of your plan, all this inconvenience has been completely removed.

By widely communicating this truly useful discovery, I am convinced, Sir, you would be rendering an essential benefit to a great number of mechanical trades, and would have many thankful acknowledgments from those who are at present unacquainted with it.

I am, Sir, &c. &c. &c.

ISAAC FREWER, *Saddler.*

In addition to the preceding Letters and Certificates, it is only necessary to state, that both Mr. West and Mr. Pepys made trial of Mr. Reveley's method, in presence of the Committee, and to their entire satisfaction.

The saving, in point of time, observed by all who have made comparative trials of oil and soap, will probably be accounted for, from the following considerations. If a blade of steel is drawn along a dry hone, certain parts of the hone will be found to be covered by a thin film of steel, abraded from the blade, and now adhering so firmly to the hone as to prevent its action in the parts thus covered. Having removed the film of steel by means of a pumice-stone, and dropping a little oil on the surface of the hone, it will now be found that the abraded particles of steel are suspended in the oil, which thus becomes discoloured; while the whole surface of the hone continues to act on the blade, except where, from the irregularities of the stone or the oblique position of the blade, a thin stratum of oil happens to be interposed. In this case, the tenacity of the oil preventing it from yielding readily to pressure, the blade is apt to slide a considerable distance, before it again comes

in contact with the surface of the stone. The tenacity of soap and water is by no means equal to that of oil, though capable of holding the abraded particles of steel suspended in it; hence the quantity of effective cutting surface of the hone is increased.

XXII.—*On Iron and Steel. By the* EDITOR.

IN this article, the Editor gives to the Public the successful results of many years' experience of his late Father, himself, and others.

The directions given, will be found to differ very considerably indeed from the methods in common use: but nothing short of the great pains taken in first ascertaining the good qualities of the materials employed, and secondly in bestowing the most accurate and minute attention to follow the directions given, can insure the excellence of the articles manufactured therefrom;—such, for instance, as smooth files, which have now been in constant use for upwards of half a century, and are esteemed invaluable by their possessors;—hand-saws, which retained their original excellence of temper, until, by constant wear and sharpening, they became turning-saws, and finally key-hole saws; and sword-blades, which were capable of cutting gun-barrels asunder, and could afterwards be wrapped around other gun-barrels without breaking; and possessing, in short, in perfection, the very opposite qualities of both hardness and toughness! These, and many other articles equally excellent, are well known by many to have been manufactured by the Editor's late father. And when it is understood that the Editor has availed himself of the knowledge he inherited from his father, to engraft thereon the additional improvements which his extensive acquaintance amongst the first practical men in this metropolis has enabled him to acquire, he trusts that the Public will consider him duly qualified to undertake the task.

ON THE KINDS OF IRON PROPER FOR CAST STEEL.

The best iron for this purpose is Swedish, of the marks Ⓛ and P, termed Hoop L, and PL: and the next best are marked ⁂ or ⁘. *i. e.* double star, or double bullet. The Swedish Government ensures the quality of the iron according to its mark: and although many other marks are imported by the merchants, and these the dearest, yet those above mentioned ought to be preferred, where cast steel of a good quality is required. The above marks are on iron made from the Dannemora or Oregrund ores, which are chiefly carbonates and oxides of iron.*

ON THE CONVERSION OF IRON INTO STEEL.

This is effected by inclosing it in earthen coffers, surrounded by and covered with charcoal, and heated in a proper furnace, (as described in the Transactions of the Manchester Society; and in Vol. I. of the Philosophical Magazine,) until, on trial, it is found to be sufficiently converted. The hardest will be found to be blistered all over its surface, whilst the milder will be smoother; and great use may be made of these indications, in selecting steel for various purposes. For cast-steel, due care should be taken that the bars are converted entirely through; as, otherwise, great difficulty will occur in fusing it, and its quality will be impaired.

ON THE DUE SELECTION OF STEEL AFTER CONVERSION.

Here the indications mentioned under the last head must be employed: for instance; for hard steel, that most covered with large blisters must be chosen; for milder steel, that which has smaller ones; and for softer and still milder steel, the smoothest must be selected, and kept apart for fusion into ingots of cast-steel, of those different qualities. And, indeed, such a selection ought to be made in choosing steel for any other purpose; as blister-steel, or

* The exportation of Swedish Iron in 1821 greatly exceeded that of the former year.

for making it into shear-steel, German-steel, &c.; for that kind of steel which is fit for making razors, saw-files, and other hard implements, is by no means fit for saws, sword-blades, springs, &c.: the first-mentioned articles requiring steel of a hard quality; whilst the latter should be made of mild steel.

ON FUSING STEEL INTO INGOTS.

The steel, after such selection, must now be broken into proper lengths, and put into large crucibles or melting-pots; and covered with a mixture of quick-lime and powdered green-glass, as a flux, and to prevent oxidation: it is then fused in a powerful wind furnace; and poured into cast-iron moulds, made in two parts, and bound together by screws, or by rings with wedges interposed, to form it into ingots, of a proper shape for making bar-steel, sheet-steel, &c.;—the sharp corners or angles being however, in all cases, removed, to prevent cracks in drawing the steel into bars; and care being taken to have them large enough for the steel to be sufficiently condensed for use, when drawn into bars, or rolled into sheets.

ON WORKING INGOTS OF CAST-STEEL INTO BARS.

The ingots should be heated only to a *worm red*, and then be subjected to the blows of a heavy forge-hammer; at first moving but slowly, until the sponginess of the ingot is overcome, and the steel acquires more cohesion; when the motion of the hammer may be increased gradually, and the bars drawn to their proper size: but, above all things, over-heating it should be carefully avoided, where the good quality of the steel is to be preserved; notwithstanding the greater length of time necessary to be employed in this operation.

ON WORKING CAST-STEEL.

Here the precautions recommended under the last head, of Working Cast-Steel Ingots into Bars, ought to be particularly attended to; for, notwithstanding what has been published by Horne, in his Essays concerning Iron and Steel, (1773,) in regard to restoring the properties of over-

heated steel, it is a fact, *that there is no remedy for this evil;* and, therefore, where the good quality of the articles is a principal object, we again repeat, that the steel should be worked with the least heat possible to forge it, notwithstanding the additional labour and time requisite in that operation; and particularly for the harder kinds, where a little carelessness in this respect would cause the steel to fly to pieces under the hammer.

ON PROVING THE QUALITIES OF CAST-STEEL.

The bars must be carefully heated at one end, and drawn down to a proper thinness for bending, about two inches in length, half an inch in breadth, and from one-eighth to one-sixteenth of an inch in thickness: this part must be then heated to the proper degree for hardening (of which see more hereafter), and quenched, leaving the thick part of the bar still hot; and then be blazed off to a spring temper (which will also be hereafter described), and again quenched. They are then fit for proving; which is effected by screwing about half an inch of the small end of the hardened and tempered part, horizontally, into the chaps of a vice firmly fixed to a work-bench, and then using the bar as a lever, walking round the vice, and bending it, until it either snaps suddenly short on being but little bent,—which marks it to be *hard;* bends until it has been carried round a quarter of a circle, and then breaks quietly off,—which marks it to be of *mild* or middling quality; or until it has been carried round a full half circle, and then only tears asunder, like lead,—which proves it to be of a *soft* quality, and well adapted for springs. The bars should now be accordingly marked with chalk, or in any other more permanent manner, with either of the letters H, M, or S, in order to distinguish their qualities into *Hard, Mild,* or *Soft,* at any future period. Should the first essay not prove satisfactory, the operation should be repeated; which the length of the part hardened and tempered will permit: for sometimes the small end may be too thin, or it may be overheated in forging, hardening, or tempering it; which is not

so likely to happen to the part adjacent to it: and when the trial has been made, the small part, so drawn out, may be broken off from the bars.

It is evident, that the same method of proving the qualities of cast-steel is applicable to all the cast-steel sold in the shops: and surely every good workman will now gladly avail himself of a certain method of assorting his steel, so as to suit the various purposes he has occasion to employ it in. And it may be observed, that every part of a bar of cast-steel will prove of the same quality as the part proved, however various the different bars themselves may be.

ON HARDENING CAST-STEEL.

Great care is indeed necessary, in this operation: for, after all the pains taken in working the steel, the whole fruits thereof may be lost, *if it be ever so little over-heated in hardening it*; and, therefore, an essay should be made, by hardening part of the same bar from which the articles were made: trying, first, even *below* the hardening heat; and if, on quenching, it should prove soft, heating it again *a little* more; and so on, by degrees, until the proper, or lowest degree of heat is ascertained, at which it will harden;—and the same degree of heat should be carefully observed, with all the articles made from that bar. When the proper degree of heat is attained, the article may be quenched, in ordinary cases, in rain water; but if for saws, or springs, in proper hardening liquids, of which more hereafter.

TO DETECT FLAWS OR CRACKS IN HARDENING.

Warm the article a little, by drawing it through the fire, and then through the coal-dust on the hearth; and immediately apply a little oil all along one side of it with a feather: in a short time, the oil will penetrate the cracks, if any exist, and appear on the opposite side, in dark marks upon the dust.

In this way, and before much cost has been bestowed upon the articles, may such flaws be detected; which would afterwards have appeared, when the expensive ope-

rations of grinding, polishing, &c. had been performed upon them.

[*To be continued.*]

XXIII.—*On Matting made from the* TYPHA LATIFOLIA, *or* GREATER CAT'S-TAIL; *by* Mr. WILLIAM SALISBURY*.

THE praise-worthy and successful endeavours of Mr. Salisbury, to open a new source of industry, peculiarly within the reach of the labouring poor, and of parochial workhouses, have received the approbation of the Society; both on their own account, and in the hope, that, by being recorded in their volume, they may excite others to similar exertions. A material hitherto unemployed, the spontaneous produce of pools and irreclaimable swamps in every part of the kingdom, peculiarly fitted to serve as the basis of domestic manufacture in the cottages of the poor, and the produce of which, whether sold or employed by the makers, will contribute essentially to the increase of their comforts, is not to be lightly passed over. One of the most serious privations to which cottagers in the agricultural districts are exposed, is that of cold during winter, arising in part from the inadequate shelter afforded by the hovels in which they live, and from the want of bedding. Their own pecuniary resources are but too often insufficient to supply the more imperious demands for food and clothing; so that, in ordinary circumstances, their sufferings from cold, during the hours intended by nature for repose and restoration, are excessively severe; as those well know, who have seen, with satisfaction not unmingled with sorrow, the joy which the donation of a single blanket invariably produces. If those who have the opportunity, would instruct and encourage the industrious poor in the

* From Vol. XXXIX. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.—Mr. Salisbury had the Ceres Silver Medal of the Society presented to him for this Invention.

manufacture of matting from the *typha*, they would thus be enabled to supply themselves with an article, which, when employed as a cover to their damp floors, as curtains to their couches, and as an auxiliary to their scanty stock of bedding, would most materially contribute both to their comfort and to their health.

The material of which matting, and the rush-bottoms (as they are called) of chairs, are usually made, is the *scirpus lacustris;* known in some parts of England by the name *bull-rush*, and in Durham and Northumberland by that of *pelecive*. It grows naturally in deep slow streams, and is particularly abundant in the neighbourhood of Newport Pagnel, in Buckinghamshire.

The demand for this article, however, in the Newport-Pagnel manufactories is considerably greater than that district can supply; and, in consequence, large importations of the *scirpus* are made from Holland. Hence, in time of war, the article is often scarce, and at an exorbitant price.

Prior to the winter of 1817, Mr. Salisbury, induced by a laudable desire of opening new sources of industry to the unemployed poor, attempted, in various ways, to apply the leaves of the *typha latifolia* (*flag*, or greater *cat's tail*) to the same purposes as the *scirpus*. For this purpose he was allowed, by the overseers of the parish of St. George's, Hanover-square, to employ some of their paupers in collecting about 2½ tons of the *typha* from the marshy grounds about Little Chelsea and Clapham; and afterwards in manufacturing a part of it into mats, baskets, hassocks, chair-bottoms, &c.

Samples of these various articles were laid before the Society in December 1817; and it appeared, that with equal skill in manipulation, equally neat work might be produced from the *scirpus* and from the *typha*. It being, however, a matter of considerable importance to ascertain the relative durability of the two articles under similar circumstances of ordinary wear, the following experiment was made:—A piece of the best Dutch matting, at 2*s*. 6*d*. a yard,

and a similar one of Mr. Salisbury's manufacture, were laid down side by side in the Society's premises, on the 13th December, 1817. Their relative situations were occasionally changed, in order to equalize, as nearly as possible, the wear to which they are exposed; and on 27th March, 1821, they were taken up and examined by the Committee of Manufactures. On minute inspection, they appeared to be about half worn out, and there was no very perceptible difference in the condition of each.

With regard to the relative expense of procuring and preparing the two articles for manufacture, the Society possess no very certain data; as the use of the *typha* was at first set on foot chiefly in order to employ those parish poor who would otherwise have been idle. Two guineas were paid by Mr. S. for liberty to cut as much of the *typha* as he pleased from about ten acres of swampy land near Hammersmith. The matting has been sold at from 9*d.* to 15*d.* per yard, and between 1000 and 1500 yards have been disposed of during the last three years.

The *typha* abounds in all marsh ditches and uncultivated swampy ground in every part of the kingdom; whereas the *scirpus* is found in quantity sufficient for manufacture only in certain districts: hence the former must be much more accessible and cheaper than even the *scirpus* of home growth; and the Society indulge the hope, that, by giving this notice a place in their annual volume, the knowledge and the use of so abundant and cheap a material may be extended throughout the kingdom, and may form a means of domestic employment to the younger members of poor families.

XXIV.—*Improved mode of propagating Vines. By the* Rev. JOHN MITCHEL*.

VINES possess so vigorous a power of vegetation, that the present most approved method of propagating them in

* From Darwin's Phytologia, p. 383.

grape-houses, consists in planting their scions. The late Rev. John Mitchel, of Thornhill, in Yorkshire, the philosopher who discovered to the world the art of making artificial magnets, (which had been concealed by Mr. Knight, whose friendship I long possessed, and whose loss I have long lamented,) amused himself and family at vacant hours in his hot-house. The observations of a man of such accurate and useful knowledge are always worth recording; and although his ideas on the subject have already appeared in Mr. Speechly's Culture of the Vine, I shall here transcribe one of his Letters to me, dated in May 1785. "The way in which we raise our vines, we account our own; for I don't know that it was practised by any body, before we set the example. It is now pretty generally adopted however, by the gardeners and nurserymen in this part of the world.—Instead of leaving three or four eyes on the cuttings, as used formerly to be done, which made them awkward straggling things, we never plant more than a single eye to each; cutting them with as long a part below the eye as they can admit, without encroaching too much upon the next eye below; that is to say, we leave, perhaps, about half an inch, or a litttle more, as it may happen, above it. These cuttings we plant by half-a-dozen or a dozen together, at the distance of three, four, or five inches, in the bark-bed, where it is pretty warm, but not so hot as to endanger the burning of the roots, when they shall come out; and where it is also pretty moist, or else we water them. We plant them sloping, so as to make an angle of about thirty degrees, perhaps a little more or less, with the horizon, the eye being highest; but taking care that it also shall be covered about an inch with the bark, which is a very necessary precaution; for though it ought just to *smell* the fresh air, it must be kept moist to prevent the bud and shoot, when it comes, from drying; otherwise it will very frequently die away presently after it has shot a little, or at best it will grow unkindly, not having yet made shoots sufficient to supply it with the sap

necessary for its support; which will not be the case, if the bud is sufficiently covered at first, and till it has acquired more roots.

"We generally plant our vines in this way about the beginning or middle of January; and if the bark is pretty warm, and as moist as it should be, the cuttings will begin to push both at top and bottom in about a fortnight, or three weeks at most. When the vines have shot a little, perhaps three or four inches, but before the roots have got too long, (in which case it would be impossible to avoid breaking them by removing, on account of their extreme tenderness and brittleness,) we displace a good deal of the bark very near them, till we can throw them down altogether, which shakes the bark very gently from their roots; so that one may disengage them sufficiently easy, and without much hurting them. We then plant three or four of the most promising and thriving ones out of the whole number, singly, in small pots, in earth which has previously stood in the hot-house a day or two, to get warm; letting the roots drop down on a little earth at the bottom, at first, as they conveniently can, and then covering them with more earth carefully, till the pot is properly filled, and the stem, about three or four inches long, as I said before, standing in the middle; and then plentifully watering the earth to settle it to the roots. We now plunge them again in the bark; where, in five or six weeks, more or less, they will have filled their pots pretty well with roots; when they will begin to shew, by their little progress and the smallness of the shoots, that they want more room. We then take them carefully out of the small pots, disturbing the ball of earth as little as possible, and put it altogether into larger pots, putting a little fresh earth at bottom and round about, and watering well, as before; and we then again plunge them into the bark.

"By about the latter end of May, or beginning of June, the best of them will be about four or five, or perhaps six high, and ought now to be removed, disturbing the roots as

little as possible, into the natural ground, where they are to remain. If this is done carefully, and the earth well watered about them to settle it to their roots, they will frequently begin growing again almost immediately, but, at least, in three or four days; and will then often shoot in the hot-house two inches in a day; and by the end of the year, will have shot, from eighteen or nineteen, to three, four, or five and twenty feet. Though we approve of this as rather the best; yet if these cuttings are planted in the same way, either singly in small pots, or two or three together in each, with earth, instead of planting them either in the bark, destroying all but the best one, when they had shot a little, and plunging them either in the bark, or, in default of a bark-bed, in a common hot-bed, they will do equally, or nearly equally well; only taking care that the hot-bed is not too hot, so as to injure the roots, of which there is sometimes danger."

XXV.—*An improved Method of Planting Vines for Forcing. By Mr. Daniel Judd, F. H. S.**

HEREWITH I send an account of my management of the vines in the garden of Charles Campbell, esq. of Edmonton, of which I have the charge.

My compost was formed as follows:—In the winter of 1817, I procured a quantity of the top-spit of soil from a common in the neighbourhood, which consisted of a rich loam, rather inclined to be gritty; which property I prefer, because it gives a porousness to the compost, thereby allowing the water to pass freely through it. At the same time I collected some lime-rubbish, well broken to pieces and sifted, some old tan, some leaf-mould, and a quantity of the richest old dung I could select from the forcing-beds and elsewhere. These materials having been kept separate, and frequently turned over in the summer, were mixed together in the autumn of 1818, in the following propor-

* From the Transactions of the London Horticultural Society.

tions: one half of loam, one fourth of lime-rubbish, united with the tan and leaf-mould. They were well mixed, by frequent turnings (but were not sifted), during the winter, when the weather was frosty or dry; for the operation should never be performed in wet weather. It may be noticed, that I did not use so much dung in my compost as is sometimes done; for I have observed, that an excess of it retards the growth of the vine, notwithstanding it is considered to be a plant which will bear an extraordinary quantity of manure. The addition of old tan to the compost, which is not usual, I recommend; because I know, from experience, that the vines will root in that, more freely than in any other substance.

In March last, the border in front of the Vinery was cleared to the depth of upwards of three feet; below which it was drained, and then filled up with the new compost, to the level of the bottom plate of the house: this was done in fine weather, and the new mould had full two months to settle well, before the young vines were planted in it.

My vine-plants were raised from single eyes, in March 1818: they were treated in the usual way through the summer, and kept from frost during winter, until March last, when they were cut down to one eye, and placed in the pine-pit, in order to produce young shoots of sufficient length to draw into the house at the time of planting. After they had made shoots about two feet long, they were removed to the green-house (which was at that time kept at a temperature of about 60° for some other purposes); here they continued growing till they had attained to the length of three or four feet: by this treatment the whole plant was rendered more hardy, and, consequently, more fit for its final removal into the open border.

Early in May, having made good the height of the border quite to the level of the holes, where the plants were to be carried into the house, so that no part of their stems should be exposed to the external air, I opened the holes for the reception of the plants, leaving them open

upwards of a week, to remove any noxious quality in that part of the compost which would first receive the roots. My planting was executed on the 13th of May; but I consider that any period between the 10th of May and 10th of June will be equally successful, provided the work be done in seasonable weather; that is, when it is neither wet nor cold.

At the time of planting, I turned into each hole a common wheelbarrow-full of very old tan from the pine-house; in the middle of which tan the roots of my vine-plants remained, after the plants had been treated as I shall now describe.—I first cut off the leaves from the lower part of the plant, about two feet and a half of its length; leaving about an inch of the foot-stalk of each on the plant, the end of which was then drawn very carefully through the holes, under the plate, without injuring the tender part of the shoot: the pot being removed, the ball, or root, of the plant was placed two feet distant from the front of the house, upon its side; so that the stem lay in a horizontal position, about six inches below the level of the surface of the border. When thus placed, the whole of the stem, which was to be covered, was slit or tongued at each eye, like a carnation-layer, by passing a sharp knife at three quarters of an inch below each eye, and on the side of the eye, about one-third of the thickness, into the wood, and then upwards to the centre of the joint. This being done, the stem was covered with about four inches of old tan, and the other two inches were filled up with the mould of the border. It is essential to the safety of the plant, that the slitting be done the last thing, and whilst it is laid in its position, lest the stem should be broken.

The effect of the operation of slitting the stem, is the production of abundance of roots from every eye. The progress is not very great, until the roots begin to push out: after these shoot, it is surprising how the vines grow. I gave a little fire in the house for the first month after

planting, though sparingly; and air was admitted into it continually, until the plants had got sufficient hold of the border: air was then admitted in the day, but the house was shut up at night. Under this treatment the shoots of the present season of these young plants are from twenty-five to thirty feet long, and their strength is fully proportionate to their length.

It is not my intention to grow any thing on the border, which will exhaust it, or deprive the vines of their full nourishment. To protect their roots in the winter, I shall use a covering of old tan, about six inches thick, which I prefer to dung or mulch of any description.

I have, this season, planted vines in the same way, in other houses, besides the one I have mentioned; and with equal success.

XXVI.—*On Improved* DRAWING PAPER, *or* TABLETS, *for* ARTISTS. *By* GEORGE STEART*. *In a Letter to Arthur Aikin, Esq. Secretary to the Society of Arts, &c. &c.*

De Montalt Paper Mills, Coomb Down, near Bath, Feb. 12th, 1819.

SIR,

I BEG you will lay before the Society of Arts, &c. the six dozen Lino-Stereo Tablets inclosed, invented and manufactured by me, for their inspection. If the Society should be pleased to consider my improvements, in an article at present in great request, worthy their patronage, I shall feel much pleasure in receiving it; and also in communicating any further information, if required.

I am, Sir, &c. &c. &c.

GEORGE STEART.

A. Aikin, Esq.
Secretary, &c. &c.

The tablets are of two sorts, *rough* and *smooth*;—the former finished with a grain or tooth, the more effectually

* From Vol. XXXIX. of the Society's Transactions.—The Isis Silver Medal of the Society was presented to Mr. Steart, for this invention.

to receive the full touch of a pencil, chalk, or crayon, for which kinds of drawing they are principally intended; while the latter have a much more level surface, for painting in water-colours, or for other delicate works.

The tablets will be sold to the public at the usual prices charged for the *pasted* card-boards. I have already manufactured many thousand dozens for that purpose.

The extra-stout drawing-papers, or card-boards, as they are usually denominated, are always made by pasting several sheets of paper together, in the manner of a common pasteboard, and afterwards bringing them to a smooth face by pressing and rolling. The pasting is a dirty operation, and the occasion of many defects, some of which are fatal to the degree of perfection and nicety required in a good drawing-board; for it often happens, that, let the workmen be ever so careful, the boards are contaminated by a portion of the paste being left on the surface in handling the sheets; and although this may at first escape the artist, yet it will be discovered, perhaps when too late, in finishing a picture. But a far more serious accident than this frequently occurs, which it is impossible to foresee or avoid; for after the artist may have spent many days, and even weeks, upon a favourite drawing,—having occasion, perhaps several times, to re-wet a particular part of it, in order to produce a desired effect in the finishing,—the adhesive qualities of the paste are destroyed, a separation of the sheets takes place, and blisters rise upon the surface, to the ruin of his labours. It has been often remarked, also, that drawings made upon pasted boards, and exposed in rooms where fires are seldom kept, have very soon been spoiled; whilst a print or a drawing on a single sheet of paper, in the same situation, has remained quite perfect. This is readily accounted for, from the great tendency of paste to mould or mildew. A fourth great defect is, that the far greater part of the drawing and writing papers now in use in this country, are of a hollow or spongy texture: this arises from their being made of an indiscriminate mixture of linen and cotton; the greater elasticity of this

latter preventing its fibres from closely uniting with those of the flax: the consequence is, an irregular surface, and a porous spongy substance, very different from that which an adherence to the good old-fashioned practice of using fine linen rags only in the manufacture of superior papers would produce. Another serious evil is, that some manufacturers, having recourse to the aid of chemistry for bleaching or whitening rags of very inferior quality, by means of the oxymuriate of lime, supply a drawing-paper sufficiently fair to the eye; but which, as it retains a part of the muriatic acid, speedily destroys the fine and delicate tints laid upon it.

The Lino-Stereo Tablet is entirely free from these objections, for the following reasons:—1st. It is not composed of several sheets pasted together, but is moulded from the pulp, of any required thickness, in one entire mass; thus the risk of pasting is avoided, and no separation of the component parts can possibly take place, though wetted ever so often. 2dly, Instead of being compounded of linen and cotton, it is wholly and solely manufactured from the best and purest white-linen rags, most carefully selected; and, consequently, without the aid of the oxymuriate of lime, or any bleaching process whatever.

SIR, *De Montalt Mills, Bath, March 4th,* 1819.

In compliance with your favour of the 28th ult. I herewith transmit some samples of the grey and other tinted tablets, manufactured from linen rags previously dyed in the pulp, which I shall thank you to lay before the Committee of Polite Arts for their inspection. I believe the colours are permanent, having made many experiments to prove the stability of the colouring materials. The whole were manufactured last summer; and I regret I cannot, at present, send more samples, from the circumstance of the stock being nearly all disposed of.

I am, Sir, &c. &c.

GEORGE STEART.

In describing the manufacture of the Lino-Stereo Tablet, it may be necessary, in the first place, to point out the requisite materials or utensils, and then explain their uses; confining myself to the technical phrases employed by manufactures in paper-mills, in order to be more clearly understood.

The Utensils.—1. A mould of the required dimensions, similar to those used for making paper, but considerably stronger, and well supported by additional bars underneath, so as to enable it to carry, or bear, a considerable weight or pressure on the face of it, without bagging; with a deckle from one and a half to two inches in depth, to retain the fluid pulp on the face of the mould, and to regulate the required thickness of the sheet or tablet: three or four of these deckles, of different depths, will be wanted, for thinner or thicker substances.

2. A second mould, or compresser, in every respect like the first, but so much smaller, that it will fall into and fill the deckle upon the face of the first mould.

3. A light press, very similar to a napkin-press, large enough to admit the mould and its compresser, which is to be placed in the most convenient station, near the vat; or in lieu of it, a weight, suspended by a pulley over the bridge, laid on the vat; but I consider the press most desirable.

4. A set of felts, of the very finest manufacture possible to be procured, of the required size, are indispensably necessary.

5. A pair of rolls, or cylinders, of large dimensions, such as are used by the rollers of fine metals, made either of iron or brass, fitted up with the greatest truth, and highly polished on the surface, must also be provided:—exclusive of all the other requisites in a well-conducted paper manufactory.

The Process.—In selecting the raw materials for the manufacture of the Lino-tablets, great care is taken to reserve the *best and purest white linen rags only*, rejecting all muslins, calicoes, and every other article made of *cotton*. The linen rags are then carefully sorted, overlooked, and

cleansed, washed, and beaten into pulp in the usual manner practised by paper-manufacturers of the first class.

The pulp being ready, and diluted in the vat by the proper proportion of pure water, the workman, dipping his first mould into the vat, takes it up, filled with pulp to the top of the deckle; and holding it horizontally, and gently shaking it, causes the water to subside, leaving the pulp very evenly set upon the face of the mould: having rested it for a moment or two on the bridge of the vat, the compresser, with its face downwards, is now carefully laid upon the sheet or tablet, and both together placed in the small press close at hand, where it is submitted to a very gentle pressure, in order to exclude a great proportion of the water remaining in the sheet:—it is then withdrawn, the compresser and the deckle are both taken off, and another workman couches it, by very dexterously turning the mould upside down, and pressing it pretty hard with his hands on one of the fine felts previously laid upon a very level pressing plank, by which means the tablet is left on the felt. The mould is then returned to the vat-man, who repeats the process as before. The coucher, in the mean time, lays another felt upon the sheet or tablet just couched, whereon the second sheet is to be laid in the same manner; and so on, till all the felts are occupied; over which another level plank is placed, and the whole drawn away on a small rail-road waggon to the great press, where it undergoes a pretty severe pressure.

The tablets will now be found to have sufficient adhesion to bear handling with care, and are separated from the felts, and placed one upon another, so as to form packs: these packs are to be submitted again to the action of the press, till more water is expelled; then are parted sheet by sheet, pressed, and parted again; and this is repeated as often as necessary, taking care to increase the pressure every operation, until the face of the tablets is sufficiently smooth: they are then carefully dried, sized, picked, sorted, &c. carried to the rolling-mill, and several times passed between the polished cylinders, to give them the last finish.

The above is the process for the plain or white tablets. In making the tinted tablets, the following additional particulars are to be attended to:—

The rags are cleansed, washed, and beaten into half stuff in the usual way; the water being drained off, the pulp is put into a vat with a solution in water, of acetate of alumine, or sulphate of iron, as a mordant or ground to fix the colour, according to the colour intended to be made: the whole is well incorporated, and suffered to remain for half an hour or more, when the colouring tincture, previously prepared, is added; after which, the whole being returned to the engine, is beaten into fine pulp, and then wrought into tablets.

The dyeing materials I chiefly make use of, are, mangrove bark, quercitron bark, best blue Aleppo galls, sulphate of iron, and acetate of alumine. A due combination of these materials produces a great variety of drabs, greys, sand-colours, &c., and, I believe, more permanent or fixed than can be produced by any other means.

The advantages to be obtained by this mode of manufacture over all others, are sufficiently explained in my former Letter.

I am, Sir, &c. &c.

A. Aikin, Esq.
Secretary, &c. &c.

GEORGE STEART.

XXVII.—*Method of ascertaining and correcting the Local Variation of the Ship's Compass, occasioned by the Influence of the Guns and other Iron on Board. By* PETER BARLOW, *Professor at the Royal Military Academy, Woolwich**.

Royal Military Academy, Woolwich, November 13th, 1820.

IN a mercantile nation like Great Britain, every attempt to improve the practice of navigation, and to diminish its

* From Vol. XXXIX. of the Transactions of the Society of Arts, &c.—Mr. Barlow, besides being elected a Perpetual Member of the Society, had its Large Gold Medal, and a complete set of its Transactions, voted to him for this important discovery.

dangers, is entitled to the favourable consideration of the public; and when in those attempts an individual has succeeded in developing any new and useful principle, the more that principle is known, the more rapid will be the consequent improvement. As the Society of Arts, &c. is ever ready to sanction with its approbation, and to encourage with its reward every useful invention or discovery, I feel desirous of submitting to its notice a method which I have proposed for correcting the local attraction of a ship's guns, and other iron, on the ship's compass; a subject which has for some years engaged the attention of the most able navigators and philosophers of this country.

That the guns, ballast, and other iron in vessels of any description, and particularly in ships of war, should have an influence in disturbing the natural direction of the compass, seems now so obvious, that we are astonished it did not long ago attract the attention of the many able English navigators, whose names do honour to the country which gave them birth: yet so far was this from being the case, that when the circumstance was first noticed by Mr. Wales, in one of his voyages with Captain Cook, neither the one nor the other of these intelligent observers was able to account for the anomaly they had detected. They found, that with the ship's head on different points of the compass, the needle pointed in different directions, deviating as much as 5°, 6°, or 7°; but the cause of the anomaly remained unaccounted for, till Captain Flinders at length discovered it to be caused by the local attraction of the iron of the vessel, and to be dependent, as to quantity and direction, on the dip of the needle.

The more recent observations of Mr. Bain, who has published a very useful work on the subject*, and of Captains Ross and Sabine in their voyage of discovery towards the North, have confirmed, in a great measure, preceding deductions, and have shewn the great necessity of devising some method of correction. In Baffin's Bay, the local attraction was so considerable, as to cause a deviation of nearly 50°,

* Bain "On the Variation of the Compass."

according as the observation was made with the ship's head pointing to the east or west. Hence there no longer remained any doubt, that the law laid down by Captain Flinders is, generally speaking, correct; viz. that the quantity of local attraction depends upon the quantity of the dip, and that the effect is also produced in opposite directions, according as the vessel is in the southern or northern hemisphere of the globe; but at the same time these observations demonstrated, that the ratio of this increase or decrease which he had assumed was entirely erroneous.

At the same time, however, that these observations demonstrated the inadequacy of Captain Flinders' rule, they did not answer the purpose of establishing any new rule more accurate. Indeed, every one had deceived himself, by assuming the east and west points to be those of greatest attraction; whereas, as will appear in this paper, those points, in certain places of the earth, are actually points of no attraction: up to this time, therefore, every thing was inaccurate and uncertain, both as it related to the determination of the quantity of deviation, at different points of the compass, and at the same points in different parts of the earth.

In this state of the inquiry, I commenced a series of magnetical experiments in the beginning of the year 1819; and was so fortunate as to discover two important facts, which promise to throw considerable light upon this hitherto mysterious subject. The one is, that in every mass of iron there is a *plane of no attraction*, viz. a plane, in which a compass being placed, *the iron has no effect upon the needle.* This plane passes from the magnetic north point to the south; and in this latitude inclines to the horizon, at an angle of 19° 24′, being the complement of the dip. The other is, that the attraction of iron on the compass depends wholly on the surface of the former, and is independent of the mass or quantity. I also discovered other laws of action, founded upon these two, which are explained in my "Essay on Magnetic Attractions," a copy of which I have done myself the honour of transmitting with

this Memoir, begging for it the acceptance of the Society of Arts.

The nature and properties of the plane of no attraction, and of the other laws which result from this fundamental fact, will be best illustrated by referring to fig. 1, Plate XIII.* In this figure, O is supposed to represent an iron ball, and A A A a sphere within in its influence; the Points S Q N Q′ being in the meridian. The line N S′, contained in the plane S E N W, denotes the natural direction of the dipping needle in these latitudes; its inclination from the horizon being about 70½°. Now, conceiving Q E Q′ W to represent a circle or plane passing through the centre of the ball, and perpendicular to the axis N S, it will be the plane of no attraction; which has this remarkable property, that if lines be drawn in it, as, for example, the lines O C, O C′, O C″, and a compass be placed any where in those lines, or, in short, in any point of the plane Q E Q′ W, it will be uninfluenced by the iron-ball, and will preserve its natural magnetic direction. But as soon as the compass is removed out of this plane, the needle is found to deviate from its original bearing; its south end being drawn towards the ball when the compass is placed below the plane Q E Q′ W, and the north end when it is above; in all these cases the quantity of deviation follows a determinate law. Suppose two other planes in the sphere A A A, each passing through the centre of the ball, and each perpendicular to Q E Q′ W, of which let M O S L, M′ O S L′, represent quadrants. Now, supposing a compass placed in each of these planes, somewhere in the lines O L, O L′, but equidistant from O, then the tangent of the deviation of the compass in O L, will be to that in O L′, as the rectangle of the sine of twice the arc L M, and the cosine of the arc E M, is to the rectangle of the sine of twice L′ M′, and the cosine of E M′, (E being the east point of the horison;) so that the deviation being known for any one situation, it may be computed for any whatsoever.

* This Plate will be given in the succeeding Number.

Having established the above laws, by the most satisfactory experiments, I next ascertained the law for different distances, finding it to be very accurately, as follows: viz. the tangent of the deviation is inversely proportional to the cube of the distance, the angular position being the same.

And when different iron-balls are employed, the tangent of deviation is directly proportional to the cube of their diameters. But what is the most remarkable, is, that notwithstanding the above law seems to indicate that the tangents of deviation are as the masses; yet balls and shells, whatever may be the thickness of the latter (provided it be not less than one-twentieth of an inch), having the same external diameter, give the same results.

The power of attraction, therefore, resides wholly on the surface; and the law becomes, *the squares of the tangents of deviation, are directly proportional to the cubes of the surfaces.* Lastly, I ascertained that all those laws which were deduced from experiments on balls and shells, have equally place in iron bodies of the most irregular forms, and ultimately in ships of war carrying the usual equipments of such vessels.

Hitherto I had proceeded on the foundation of experimental results, and had carefully abstained from advancing any thing which might be considered hypothetical; but seeing the beautiful uniformity and simplicity of the laws above stated, I could not refrain from concluding, that the remarkable fact of the plane of no attraction being perpendicular to the direction of the dipping needle, was not accidental or peculiar to these latitudes, but that the same had place in every part of the world; and it was on this ground I proposed the method which I have endeavoured to explain for correcting the local attraction of vessels. It is clear, however, that, independent of observations in other parts of the world, this conjecture, however reasonable and probable, could not be received amongst the established principles of magnetism; and I therefore esteem myself

highly fortunate in having lately found that Mr. P. Lecount has been carrying on a course of experiments, in some measure similar to my own, on board H. M. S. Conquereur; and by attentively observing the various phenomena presented by iron bodies on the magnet, in his passage from St. Helena to England, he has most satisfactorily demonstrated, the accuracy of my deduction relative to the varying position of the plane of no attraction in different latitudes, but at the same time wholly independent of any thing I had done, and indeed without being aware that such a work as mine had ever been published.*

[*To be continued.*]

XXVIII.—MISCELLANEOUS.

Gas supplied in a portable state.

PUBLIC and private buildings may now be lighted with gas, in a satisfactory manner, on a plan lately perfected by Mr. W. Caslon, of Burton Crescent, who condenses a quantity of gas into cylindrical iron vessels, with convex ends, proved with a pressure considerably greater than that produced by the elasticity of the compressed gas. These vessels are sent to the premises where the gas is required, and are then connected to the pipes and lamps by union-screws. The gas passes through two machines, of simple construction; one for regulating the pressure, the other for measuring the quantity consumed; and a mercurial-guage indicates when the quantity of gas in the vessel is getting low. The gas which is supplied in this way, being produced from oil, the necessary apparatus, and the pipes, lamps, and burners, are not liable to get out of repair—a consideration of importance, as coal-gas unavoidably corrodes and destroys them. The vessels hold about seventy cubic feet of gas each; and one foot supplies a burner for an hour, affording the light of twelve ordinary tallow candles.

* See Lecount "On the Polarization of Iron."

Accidents are, however, liable to happen from the power of the compressed gas, unless the vessels are made remarkably strong. We have heard of one case.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since Dec. 22, 1821.

To Pierre Erard, of Great Marlborough Street, in the county of Middlesex, Musical-instrument-maker, in consequence of communications made to him by a certain Foreigner, residing abroad, for certain improvements on Piano-Fortes, and other keyed Musical-instruments. Dated December 22, 1821.—To be specified in six months.

To George Linton, of Gloucester Street, Queen Square, in the county of Middlesex, Merchant, for a new method of Impelling Machinery without the aid of steam, water, wind, air, or fire. Dated December 22, 1821.—In six months.

To Richard Ormrod, of Manchester, in the county of Lancaster, Iron-founder, in consequence of a communication made to him by a certain person residing abroad, for an improvement in the mode of Heating Liquids in Boilers, and thereby accelerating and increasing the production of Steam. Dated January 7, 1822.—In six months.

To William Ravenscroft, of Serle Street, Lincoln's Inn Fields, in the parish of St. Clement Danes, in the county of Middlesex, Peruke-maker, for his new-invented Forensic Wig, the curls whereof are constructed on a principle to supersede the necessity of frizzing, curling, or using hard pomatum: and also, for the tails of the wig not to require tying in dressing; and further, the impossibility of any person untying them. Dated January 14, 1822.—In two months.

To Richard Summers Hartford, of Ebbro-Vale Iron Works, in the parish of Aberystwith, in the county of Monmouth, Iron-master, being one of the people called Quakers, for his improvement in that department of Ma-

nufacture of Iron commonly called Puddling. Dated January 9, 1822.—In four months.

To James Harris, of St. Mildred's Court, in the city of London, Tea-dealer, for his improvement in the Manufacture of Shoes for Horses and Cattle. Dated January 9, 1822.—In six months.

To David Loescham, of Newman Street, Oxford Road, in the county of Middlesex, Musical-instrument-maker; and James Allwright, of Little Newport Street, in the parish of St. Ann's, Soho, in the county of Middlesex, Cheesemonger; in consequence of a communication from a foreigner, residing abroad, of a new or improved Keyed Musical-instrument, comprising in itself many qualities never hitherto produced in one instrument; and possessing those qualities, in clearness of sound, quality, distinctness, forte, piano, delicacy of touch, and shake on the keys or notes, by increasing to forte, and decreasing to piano, at the will of the performer. Dated January 14, 1822.—In six months.

To Alexander Gordon, of the city of London, and David Gordon, of the city and county of Edinburgh, Esqrs., for their improvements and additions in the Construction of Lamps; and of Compositions and Materials to be burned in the Lamps; and which may also be burned in other lamps. Dated January 14, 1822.—In six months.

To David Gordon, of the city and county of Edinburgh, Esquire, for his certain improvements and additions to Steam-Packets and other vessels; part of which improvements are applicable to other Naval and Marine purposes. Dated January 14, 1822.—In four months.

To Augustus Applegath, of Duke Street, Lett's Town, Lambeth, in the county of Surrey, Printer; for his certain improvements in Printing Machines. Dated January 14, 1822.—In four months.

THE

TECHNICAL REPOSITORY.

XXIX.—*Specification of the Patent granted to* JAMES SMETHURST, *of St. Margaret's Hill, Southwark, in the County of Surrey, Lamp Manufacturer and Contractor; and* NICHOLAS PAUL, *of Villiers Street, Strand, in the County of Middlesex, Mechanician; for certain Improvements applicable to Lamps and Reflectors.—Dated 30th Oct.* 1802. *Term expired.*—[Continued from p. 13.]

WITH AN OCTAVO AND A QUARTO PLATE.

IN the drawing No. III., plate XI., fig. 1, represents a lamp for lighting halls, passages, staircases, or other similar purposes; and which is likewise capable of being used as a bracket or table-lamp: it consists of some parts which are common to the lamp last described, and shewn in fig. 7, of the drawing No. II.; and the same letters of reference apply also to it. The variations are as follow:—The tube, C, is shortened; and below the moveable ring, *c*, of the air-register, S, a base or foot, W, is fixed, having within it an additional tube, X, made somewhat tapering; the use of which is, to place the lamp in the socket of a candlestick, or the catch-box of a glass vase, such as is commonly used for a passage-lamp; in which latter case the circular-reflector, Q, may be also suspended in the glass vase, by means of the chain and hooks, Y, Y, Y: and by means of the circular hole in its centre, being made wider, as seen at Z, it will not so much hinder the light of the lamp from

proceeding upwards, and will still reflect some of the rays underneath the lamp. When the said circular-reflector is intended to be used with a table-lamp, it may be suspended by means of branches fixed to it; and may also be fixed to a socket, sliding upon the supporter of the glass dome or chimney, D.

In the drawing No. IV., plate XII, fig. 1, represents a mode of adopting one of the circular-reflectors, Q, to a common patent lamp, having a circular reservoir for the oil above. In order to this, a hook is fixed to the tube proceeding from the said reservoir; a recess or slit is made in one side of the reflector, to admit the tube; and close to the said slit is made a hole, to permit the said hook to pass through, by which means the reflector is sustained on that side. On the other side of the reflector, a small piece is fixed, having a hole through it; and another corresponding hole being made underneath the reservoir, the reflector is put into its place, by being suspended upon the hook, fixed to the tube, from the reservoir, on one side; and having a metal pin, put through the hole in its piece, and in the reservoir on the opposite side, to complete its suspension.

Fig. 2, of the same drawing, represents our mode of adapting one, two, or more burners, with either one or two flat wicks in each; or one or two more burners, with circular wicks; to such a vase, or other reservoir for oil, A, upon a stand, as is commonly in use, by means of our screwed conical joints; so that any of them may be employed at pleasure; and that they may easily be separated, in order to clean them, or for any other purpose. B is a burner, composed of a metal tube or body, to contain the oil; and a wick-holder, C, having two flat wicks, *c*, *c*, parallel to each other, with an air-pipe, *b*, placed between them; the lower end of which, being open, has a register, F, to admit and regulate one part of the air, which supports the combustion of the oil employed. D, is a glass dome or chimney, on an improved construction; it having a dome at *d*, *d*, and a

narrow tube above; and being made longer in the part below the flame, than those hitherto employed. It is fitted into a proper supporter, E, which has a spring tube at *e*, to enable it to be fitted upon the outside of the body of the burner, B, so as to slide up and down, and be retained in the desired position at pleasure; and it has also a ring or hoop, *f*, *f*, above it, to confine the glass chimney, and keep it steady. A number of holes are made through that part of the supporter, E, in which the glass chimney, D, rests, in order to suffer another current of fresh air to pass through them, which moves with rapidity between the body of the burner, B, and the elongated part of the glass chimney, D, and, being reverberated upon the flame, by means of the dome of the chimney at *d*, *d*, completes the combustion of the oil; and the heated and decomposed air escapes with velocity, up the narrow tube of the chimney. A plan of this part of the supporter, with its holes, is also represented separately at E, fig. 8. Another improvement in the construction of this lamp, consists in removing the ring or hoop, *f*, *f*, of the supporter, E; as the glass chimney, D, is elongated so far below the flame of the lamp, as for the ring or hoop, *f*, *f*, not to hinder the rays of light, thereby produced, from proceeding on all sides. The wick-holder, C, is supported in the body of the lamp, B, upon three or more short pins, as seen at *g*, *g*, *g*. G, is a small glass cup, supported in a metal ring, to detain any oil which might leak from the burner, B. Figs. 3, and 4, represent the double wick-holder of the burner, B, shewn in two different positions. In fig. 5, H is a lamp, composed of a metal tube or body, to contain the oil; and having a wick-holder, *h*, with one flat wick: the upper part of this tube is made sloping or tapering on each side, at *i*, *i*; in order to conduct the fresh air, which passes through the holes in the supporter, E, of the glass chimney, D, just described in fig. 2, in two currents, one on each side of the flame. The wick-holder, *h*, may be either supported on four short pins, withinside the

body of the burner, H; two of which are shewn at *g*, *g*; or as shewn in figs. 6 and 7, which represent the single wick-holder, in two different positions, with hooks, *j*, *j*, projecting at each end, whereby it may be supported on the top of the body of the burner, H. In figs. 20, 21, and 22, E, E, E, exhibit other modes of forming the supporter, E, of the glass chimney, D; so as to make it serve as a register for the admission of fresh air. Instead of holes being made in the part which supports the glass chimney; it is composed of two metal plates, both of which have one, two, three, or more similar holes, with spaces between them, equal to their diameters: the lower plate being moveable, it can, by means of the stud, *p*, which projects from it below, be turned, more or less, so as to shut or open the holes, and thereby suffer more or less air to be admitted, as may be found necessary. Instead of using a spring tube for fixing the supporter, E, of the glass dome or chimney, on the burner of the lamp, as in figs. 2 and 5; the tube, *k*, may be divided half-way round at *l*, *l*, and again at *m*, so as to fit loosely upon the outside of the burner B, fig. 2, H, fig. 5, or I, fig. 9; and the two ends, *n*, *n*, being bent at right angles, and perforated, and being connected by the screw, *o*, it may, by tightening this screw, be retained in any situation on the outside of the said burners. In fig. 9, I, is a semi-cylindrical section of a burner, having a circular wick, and a contrivance for raising it. The different parts of this burner are shewn separately by figs. 10, 11, 12, 13, 14, and 15; and the same letters of reference apply to them all. Fig. 10 shews the body of the burner to contain the oil: it consists of two tubes, the innermost being fixed to the outermost, at its lower part; and, being open below, has an air-register, F, to regulate one part of the air, which supports the combustion of the oil; and a projecting rib, *q*, *q*, fixed to it; the use of which will be described hereafter. To the lower part of the outer tube

is fixed a short tube, *a*, on the outside of which is a male screw, and the inside of which is made conical; the use of which will likewise be presently described. Holes are made through the said outer tube, where the above-described short tube is fixed to it, to admit oil, and keep out any extraneous substance. Fig. 11 shews that part of the burner, K, which serves to raise the wick; it consists of two tubes fixed to each other at top, and having a space between them sufficient to permit the outer tube of fig. 10, I, to pass between them. The inner tube has a spiral groove, or screw-like channel, *r*, *r*, *r*, *r*, *r*, *r*, *r*, *r*, *r*, *r*, made within it. Figs. 13 and 14 exhibit two different views of the wick-holder; it being a short tube, the upper outside half of which is made of a lesser exterior diameter than the lower, in order to receive the circular wick of the lamp upon it, which is confined in its place by the thin metal ring or ferule, fig. 15, being slipped over it. This wick-holder slides up and down upon the inner tube of the burner, I, fig. 10; and is prevented from turning round upon it, by means of a groove, *s*, withinside of it, which receives the projecting rib, *q*, *q*, fig. 10, before described. The exterior surface of the lower part of the wick-holder has a number of perpendicular furrows made round it, as represented in fig. 13, to permit the oil to pass by it to the wick; and has, besides, a short pin or stud, *t*, fixed to it, which slides in the spiral or screw-like groove, *r*, *r*, *r*, &c. on the inside of the inner tube, K, fig. 11, before described; so that by means of the said tube being turned either one way or the other, the wick-holder is raised or lowered. Fig. 12 is a metal ring, which fits on the inside of the top of the tube, K, fig. 11, and is made conical withinside; its use is to confine the wick.

To this burner the glass chimney, D, and its supporter, E, are adapted in the same manner as is shewn in figs. 2 and 5: and the supporter being attached by means of its spring or screw tube, *e* or *k*, to the outer tube K, fig. 11; upon its being turned either one way or the other, the said

outer tube, K, is consequently turned with it, and thereby raises or lowers the wick of the lamp. Figs. 16, 17, 18, and 19 represent the parts which form our screwed conical joint, shewn in different positions. Fig. 16 exhibits part of the pipe which proceeds from the reservoir, A, fig. 2; leaving the part, *a*, of the joint fixed to it. This part, *a*, is made conical at the end, on its outside, and so made as to fit exactly into the conical part of the short-screwed tube, *a*, fixed to the burners, B, fig. 2, H, fig. 5, and I, figs. 9 and 10. This pipe, fig. 16, has, besides, a projecting shoulder at *u*, *u*, for the inner part of the screwed ring, *a*, fig. 17 and 18, to press against; and this ring being screwed upon the outside of the short conical tube, *a*, figs. 5, 9, and 10, either by means of its milled edge, or by means of the claws of the wrench, fig. 24, being inserted into the two slits or notches, *v*, *v*, made in the said milled edge for that purpose, until it is tight, it will bring the conical parts of the joint, *a*, into close contact with each other, and render the joint sufficiently secure. Fig. 23 exhibits, by dotted lines, a mode of applying our egg-shaped reflector, which reflects the light in one direction only (and which is hereinafter described), to a lamp with either one or two flat or circular wicks.

[*To be continued.*]

XXX.—*Method of ascertaining and correcting the Local Variation of the Ship's Compass, occasioned by the Influence of the Guns and other Iron on Board.* *By* PETER BARLOW, *Professor at the Royal Military Academy, Woolwich.*—[Concluded from p. 158.]

ONE serious difficulty, however, still remained; namely, that all these laws had reference to the dip of the needle, which it is perhaps impossible to ascertain at sea, while the vessel is in motion; and I was therefore led to seek for

some method by which this difficulty might be avoided; and it is this practical and mechanical principle which I am desirous of explaining to the Society of Arts; not in its original, but in its improved form. Since the iron of the vessel and the compass maintained the same relative situation with respect to each other during the voyage; and since all the action of the iron may be considered, like that of every other attraction, to be reducible to one common centre, or, in the language of mechanics, to "one resultant;" it is obvious, that the effect produced by the distributed iron, is the same as that which would take place from a single large globe of iron, of which the centre should coincide with that centre of attraction. And since a small ball of iron, at a small distance, will produce precisely the same effect as a larger ball at a distance proportionally greater; if we consider a line to be drawn from the compass to the centre of attraction of the vessel, and if we fix in that line, but nearer to the compass, a small ball or plate of iron, the action of the latter will be the same as that of the former (the distance being properly adjusted); and being so in one situation, it must continue so in all, because the line joining the centre of attraction with the pivot of the needle will be constantly fixed, as regards the vessel itself, at all times and in all parts of the world.

To be a little more particular in my description, let C (fig. 2, Plate XIII.) represent an azimuth compass in a certain situation in the vessel, viz. one selected for making observations on the sun's amplitude and azimuth*; and let S be the centre of attraction of the iron of the vessel; let also P represent a plate of iron, having its centre in the line joining S and C, which let us suppose to be fixed at such a distance, that its action on the compass may be the same as

* Formerly azimuth and amplitude observations were made in any part of the vessel; but since the effect of the local attraction has been known, navigators are acquiring the habit of taking them at a certain fixed place.

that of the iron at S; then it is obvious, since the plate, the compass, and the vessel all move together, that it will continue, in all directions of the vessel and in all parts of the world, to produce the same effect as the distributed iron, whatever change may take place in the dip, and in the magnetic intensity. This, then, constitutes the principle of my method of correction; viz.

When a vessel has received on board her guns and stores, let her be warped round point by point, to ascertain the quantity of her local attraction*, and let the situation of the plate be determined (by the directions that follow), so as it may produce the same effect as the iron of the ship; and consequently, so that when the plate is applied, the effect may be doubled. This being done, let the plate be laid aside; and when at any time it is desirable to ascertain the effect of the guns, &c. on the compass, let it be applied to its assigned situation, and observe how many degrees, &c. it attracts the needle out of its prior direction, and just so much will the guns have drawn the same from its true magnetic bearing before the experiment. This being ascertained, and the course of the vessel corrected accordingly, the plate is to be removed and laid aside, till some new circumstance renders its application again necessary.

These directions, however, must be considered as only applicable when the plate is attached to the binnacle compass, as I have proposed in my Essay: when it is applied to the azimuth compass (the improvement to which I wish to draw the attention of the Society), the directions are then somewhat different, although the principle is the same.

Before I describe these, I should observe, that having laid the above proposition before the Admiralty, and my communication being by that Board submitted to the Secretary of the Board of Longitude; and Sir George Cockburn, Mr. Croker, and some other gentlemen belonging to the Admiralty, having done me the honour to be pre-

* See Note 1.

sent at a series of my experiments on the 24-pounder above mentioned, orders were immediately given for trying them on board some of H. M. ships. It was in consequence of my experiments on board H. M. S. Leven, and profiting by the practical and theoretical knowledge of her officers, that I changed the application of the plate, from the binnacle to the azimuth compass, as being more susceptible of nice observation, besides possessing other advantages, not to be obtained in the former case†. The following are the directions which I left with Captain Bartholomew and the other officers of that ship, for using the plate:

When an azimuth, or amplitude of the sun, or any other heavenly body, is taken for the purpose of determining the variation, the observation is to be made as usual, and immediately repeated again with the plate attached; and the difference in the two bearings will be the local attraction.

For example: Suppose the first observed bearing to be 67°, and the same with the plate attached 70° 30′; then

70° 30′		67° 0′	
67 0		3 30	
3 30	local attraction	63 30	correct azimuth.

Again: Let the amplitude, by observation, be 13° 30′, but with the plate only 10° 30′; then

13° 30′		13° 30′	
10 30		+3 0	
3 0	local attraction.	16 30	true compass amplitude.

At other times, to find the local attraction, take the bearing of the ship's head or of any other part of the vessel by the azimuth compass; then observe the same

† See Note 2.

again with the plate attached, and the difference will be the local attraction; it being understood, that, in all cases, when the first-observed bearing is diminished by the plate, the difference is to be added to the first bearing; and when the first angle is increased by the plate, the difference is to be subtracted.

These are all the directions which are necessary for using the plate; and I trust they are such as cannot be misunderstood by any seaman, entitled to be considered as a practical navigator.

Similar experiments were made by order of the Admiralty, on board H. M. S. Conway, Captain B. Hall, and the same directions given; but as this vessel is now upon a long and interesting voyage in the southern hemisphere, it may be some considerable time before I hear from her able and scientific commander.

From the Leven I have already received the most satisfactory account, by a letter from Lieut. Mudge (who, with the other officers of that ship, took the greatest interest in the subject), an extract of which I have annexed to this memoir.

It now only remains for me to describe the nature of the plate, and the mode of adjustment. As to the plate itself, it consists only of a circular piece of iron, having a hole and socket in its centre, for placing it upon its pin; or it may consist of two thin plates* screwed together, having a thin piece of board between them: this, however, is only for the sake of correcting slight inequalities, and for giving it some thickness without increasing its weight, in order to prevent its being bent by any fall or blow. A plate of twelve inches diameter, and weighing about four or five pounds, is sufficient for correcting the local attraction of any ship in the navy; its distance from the pivot varying from thirteen to sixteen inches, according to the power of attraction in the vessel.

The best method of determining the proper situation of the plate is to proceed as follows:

* See Note 3.

First, warp the vessel round point by point, and on each point take the bearing of an object on shore, while a person on shore, from the same spot, is taking the bearing of the compass on board; by which means it is obvious the local attraction at every point will be ascertained; for, independent of the latter, the bearings at each observation ought to be diametrically opposite, or differing by 180°; and what the difference exceeds or falls short of this, is due to the action of the iron on board.

This being determined, let a log of wood (A B, fig. 4) having no iron about it, be taken on shore, and let holes be bored in at 8, 9, 10, &c. inches from its top, to receive the brass horizontal rod R, which is to carry the plate: this pin being inserted in one of the holes, and the compass set on the top of the log, place the plate on the pin, at any distance (as shewn in the figure); now turn the log about point by point, and, by removing the plate from the pin at every observation, ascertain the deviation produced by the iron; then, if these deviations, at every point, be the same as those found to obtain on board, the plate is properly adjusted; but if this should not be the case (as is the most likely to happen), shift the height and distance of the plate, and try the same again; and, after a few trials, the exact position will be determined, so that the deviations on board, and on shore, agree with each other†. This being done, measure very accurately the depth of the centre of the plate below the pivot of the compass, and its distance from the vertical passing through the same: then cause a hole to be bored, and a socket to be introduced into one of the legs of the tripod used for the azimuth compass on board; so that when the brass pin is inserted, as shewn in fig. 2, the centre of the plate may be at the same depth below, and distance from the vertical passing through the pivot of the compass, as was determined on shore, and it will be the fixed situation required. The plate and pin are of course both moveable, and are laid aside except at the time of making the observations

† See Note 4.

above described*. It only remains to add, that as it is important that the place of observation in the vessel should be constantly the same, it will be advisable to have three small holes made in the deck for fixing the position of the feet of the tripod.

If, as may sometimes happen, the observations cannot be made from this fixed station, it will be to no purpose employing this plate; and all that can be done will be to repeat the observation again in the proper place the first opportunity.

Extract of a Letter from Lieut. MUDGE, *of H. M. S. Leven, to Mr.* BARLOW, *Royal Military Academy.*

H. M. S. Leven,
Teneriffe, Santa Cruz.

DEAR SIR,

I CANNOT resist the pleasure the writing to you affords me; and I trust, if you should think my communication rather premature, you will excuse it, and attribute it to the pleasure I derive from your invention carrying me beyond my bounds. I shall state in full detail all the circumstances which relate to your plate and compass†, as I think you will be pleased to hear how admirably it has succeeded in every respect.

I have found, in every instance, that, with the assistance of the plate, the true variations are very closely determined, which is of course a great object. I have a register of the whole, which I shall send on our return.

In consequence of our finding an extraordinary error in the two compasses by which we steer, occasioned by local attraction, I have made a point of comparing them with your plate and compass on every point we steered, and of registering their difference. In some instances I have found the deviation by the starboard compass 8°, and greatest when the ship's head is south, which appears to arise from the mass or quantity of iron which is abreast of the compass; and perhaps the centre of attraction, when a compass

* See Note 5.

† The compass here alluded to is one made by Messrs. Gilberts, 148, Leadenhall-street.

is placed there, may lie in the side abreast; but it matters little, as your plate has, and I make no doubt will always, detect the error. I shall relate a circumstance where we detected such an error in one of the compasses, arising from local attraction, that might have been the cause of the ship being wrecked, had we been amongst shoals or rocks.

On the 22d of May, at noon, we were in latitude 41° 46′ N. and long. by chronometer 9° 53′ W. Taking this as our departure, we sailed by the starboard compass S. 46° W. 183 miles: this placed the ship on the 23d, allowing the variation 21° W., in latitude 38° 58′ N. and longitude 11° 26′ W.; whereas the observations at noon for latitude, and sights in the morning for longitude, gave lat. 38° 39′ N. and long. 10° 58′ W. So great a difference in 24 hours was attributed to a current, till I compared the starboard or steering compass with the one with your plate, when I found no less than 7° error, to be subtracted from the course steered; making the true course S. 17° W. instead of S. 24° W. which had been taken as correct. By allowing the 7° which we found subtractive from the course, our latitude was, by reckoning, 38° 41′ N. and long. 11° 02′ W.; which agree with observation as close as we can ever expect it to do under any circumstances.

Believe me, Sir, &c. &c. &c.

WM. MUDGE.

Such is the present state of this method for correcting the local attraction of vessels, which, to be generally useful, must be rendered public: and nothing will more facilitate this object, if it should meet the approbation of the Society of Arts, than giving the present memoir a place in one of the volumes of its Transactions; and I am in hopes, when the importance of the subject is considered, it will not be deemed unworthy of such a distinction.

PETER BARLOW.

NOTE 1.

THE method of warping a vessel about, under different circumstances, will suggest itself to any practical navigator: at the same time, it may not be improper to describe here

Experiments on board H. M. S. LEVEN, *at Northfleet, April* 17*th and* 19*th,* 1820, *by Mr.* BARLOW *and the Officers of the above vessel.*

GUNS NOT ON BOARD.			GUNS ON BOARD.			
No. of Experiments.	Bearing of Ship's Head.	Difference in Bearing or Local Attraction.	No. of Experiments.	Bearing of Ship's Head.	Difference in Bearing or Local Attraction.	Local Attraction shewn by the Plate.
1	N 77° 0′ W	−2° 22′	1	N 71° 0′ W	−2° 51′	—
2	N 68 30 W	−2 25	2	N 64 0 W	−2 07	2 20
3	N 57 0 W	−1 37	3	N 57 0 W	−1 39	-
4	N 47 0 W	−1 54	4	N 47 0 W	−1 45	-
5	N 32 0 W	−1 12	5	N 31 0 W	−1 39	1 30
6	N 20 0 W	−1 20	6	N 24 0 W	−1 10	1 0
7	N 14 30 W	−0 12	7	N 15 0 W	−1 19	-
8	North.	+0 15	8	N 6 0 W	−0 17	0 40
9	N 5 0 E	+0 54	9	N 4 0 W	+0 8	-
10	N 16 0 E	+1 32	10	North.	+0 24	0 0
11	N 32 0 E	+1 48	11	N 5 0 E	+0 11	-
12	N 45 0 E	+2 25	12	N 13 0 E	+0 29	0 40
13	N 52 0 E	+2 26	13	N 23 0 E	+0 46	1 0
14	N 67 0 E	+3 15	14	N 57 0 E	+1 27	1 30
15	N 74 0 E	+5 6	15	N 59 0 E	+2 32	-
16	N 83 0 E	+2 31	16	N 72 0 E	+2 23	2 10
17	East.		17	N 80 0 E	+2 51	-
18	S 81 15 E	+2 34	18	S 86 0 E	+2 11	2 30
19	S 75 30 E	+2 30	19	S 85 0 E	+2 34	2 30

The rapidity and force of the tide at Northfleet prevented our warping the vessel about point by point, which is doubtless the best way. This, however, is easily practised in Portsmouth Harbour, where the above experiments were again repeated by the officers of the Leven, and the plate ultimately adjusted to the latter results, which, as I am informed by Lieut. Mudge, somewhat exceeded the above.—The following experiments were made, according to the latter method, on board H. M. S. Conway, by order of the Admiralty.

Experiments on the Local Attraction of H. M. S. CONWAY, *Portsmouth Harbour, July 24th,* 1820, *by Captain* BASIL HALL, *and Mr.* BARLOW *of the Royal Military Academy.*

Dip, 70° 30′ 3.

No. of Mean Observations.	Direction of Ship's Head.	Observed Bearing of the Station on Shore, from the Ship, by Capt. Hall on Board.	True Bearing of the Station on Shore, from the Ship, as observed by Mr. Forster on Shore.	Local Attraction.	No. of Mean Observations.	Direction of Ship's Head.	observed Bearing of Station on Shore by Captain Hall.	True bearing observed by Mr. Forster.	Local Attraction.
1	S b E	N97° 0′E	N 95°40′E	+1°20′	17	SS E	N 97 0′E	N 97°15′E	−0°15′
2	South.	96 0	94 3	+1 57	18	SE b S	95 50	96 22	−0 32
3*	S b W	95 20	92 57	+2 23	19*	S E	94 10	95 16	−1 6
4*	S S W	95 10	92 19	+2 51	20	S E b E	93 20	94 24	−1 4
5*	SW b S	94 8	91 0	+3 8	21	E S E	91 0	92 30	−1 30
6*	S W	94 2	90 47	+3 15	22	E b S	89 30	91 52	−2 22
7*	SW b W	93 35	90 15	+3 20	23	East.	87 50	91 15	−2 25
8	W S W	93 30	88 32	+4 58	24	E b N	85 0	89 5	−4 5
9*	W b S	92 10	87 32	+4 38	25*	E N E	83 20	86 34	−3 14
10	West.	-	-	-	26	N E b N	82 10	85 31	−3 21
11	W b N	88 0	84 25	+3 35	27	N E	82 15	84 58	−2 43
12	W N W	86 35	83 12	+3 23	28	NE b N	83 0	85 13	−2 13
13	NW b W	85 20	82 27	+2 53	29	NN E	85 50	88 4	−2 14
14	N W	83 25	81 46	+1 39	30	N b E	84 40	85 47	−1 7
15*	NW b N	84 17	82 7	+2 10	31*	North.	83 0	83 7	−0 7
16*	NN W	83 35	82 3	+1 32	32*	N b W	82 28	81 38	+0 50

1. All the numbers in the preceding Table marked thus* are those in which two or more observations were made at the same point, and the mean of the two taken. In the others, we had not an opportunity of making more than one observation,

2. Where the apparent or observed easterly bearing *exceeds* the true easterly bearing, the error or local attraction is marked + (plus); and when the former is *less* than the latter, the error is marked — (minus).

3. With the ship's head at west, the object on shore could not be seen.

NOTE 2.

It may be proper here to offer a few remarks on the advantage which will, I conceive, arise from attaching the plate to the azimuth, instead of to the binnacle compass.

In the first place, as there are always two binnacle or steering compasses placed abreast of each other, they must necessarily be situated either very considerably out of the fore and aft line of the vessel, or be placed so near as to influence each other's direction.

For these reasons, these compasses seldom agree with each other; viz. in the latter case, in consequence of their mutual action; and in the former, on account of each being exposed to a different system of local attractions. Therefore, to render the method which I have proposed in my Essay effective, two plates must be employed; viz. one to each compass. Moreover, the motion of the vessel renders exact observations on these compasses very difficult, if not impracticable: whereas, with a good azimuth compass, the nicest observation may be made, and the slightest deviations detected: to which we may also add, that the direction of the needle being, with this instrument, determined by observation on a distant object—as, for example, the Sun—no error will arise from a change in the direction of the course during the observation; while in the other case we have no mark of direction but the *lubber-line*, which is, we may say, in nearly a continual state of oscillation, from the corresponding motion of the ship itself.

NOTE 3.

In my Essay, I have described the plate as being *double*; and those which I have sent out in the Leven and Conway are of that kind. But I have since found that a single plate may be very safely employed, provided we give it sufficient thickness.

The double plate was employed by me in consequence of observing, that in very thin sheet iron, certain parts contained a degree of partial magnetism; and by using two plates, and ascertaining their strong and weak points of attraction experimentally, and combining them accordingly—viz. the weak point of one in contact with the strong point of the other—these partial actions were neutralized. But, by using iron weighing about 6 lbs. to the square foot, the double plate may be dispensed with; the partial action in sheets of this thickness producing no anomalous effect upon the needle, at the distance at which they are placed in the experiment.

NOTE 4.

In reference to the directions for fixing the plate, so that it may give the same errors as the ship at every point of the compass, it may be proper to observe, that in the trials by which this is effected, it will be sufficient to attend to these deviations at three points only, besides the north and south; for if the deviations caused by the plate are the same as those given by the vessel at any three points in one semi-circle (besides those corresponding to the meridian), they must necessarily be the same at every point. It will, however, be proper to make choice of three points at some distance from each other, that the change may be rendered the more obvious. I generally use the East, NE. by N., and SE. by S.; for if we take points nearer to the north or south, the deviations are too inconsiderable to render the increase or decrease arising from a change of position sufficiently obvious. It will in course be the same if we use the West, NW. by N., and SW. by S. for this purpose.

After all, however, this is by far the most difficult part of the process, for persons wholly unacquainted with magnetical experiments; and the best way, in such case, will be to purchase a plate already corrected; that is, a plate whose effect has been experimentally determined for various positions and distances. Then, having warped the vessel about point by point, and determined its local attraction, it will only be necessary to select from the table delivered with the plate, the series of deviation agreeing with those of the vessel; and opposite to that series are placed the proper distance, height, and positions which the plate ought to have, in regard to the compass to which it is to be applied *.

It is only necessary to observe, that the table alluded to will only answer while the dip of the needle, at the place where the experiments are made on the ship, and at that place where the plate is adjusted, are the same, or nearly so. In order to ascertain how far any correction was necessary in this respect for the various British ports, I solicited permission of the Honourable Commissioners of the Navy to be allowed a small vessel, in order to visit our various naval stations, and there to ascertain the actual dip of the needle by experiment. This permission was most readily and cordially given by that Honourable Board, to whom, both on this and on other occasions, I am highly indebted: and Commissioner Cunningham, of Woolwich Yard, having received directions to appoint a vessel, he, in the most handsome manner, though necessarily with some personal inconvenience, appropriated to this service the Thames long-boat, a vessel possessing every accommodation that could conduce to my convenience and comfort.

Thus provided, I visited all our naval establishments in the Channel, and ascertained the dip of the needle at each, as well as at several other prominent points; but I found the difference in the dip so very small, as to render any

* Plates, with the requisite Tables, may be had of Messrs. W. and J. Gilbert, Mathematical Instrument-makers, 148, Leadenhall-street.

correction for it perfectly unnecessary: consequently, the plate and table alluded to above will answer for any port in the British Channel. Whether there be any sensible increase of dip in our northern ports, is a question which can only be answered by means similar to those above described, that is, by actual experiment.

The instrument which I employed in making these observations was an excellent dipping-needle, constructed by Mr. Jones, Mathematical Instrument-maker to the Ordnance, who very obligingly favoured me with the loan of it for the above purpose.

NOTE 5.

Some readers will perhaps form a better idea of the principles of the method I have endeavoured to describe, by the representation and description of the model which I have the honour of presenting to the Society, and of which figures 5 and 6 are an elevation and plan. TT is a table, in which is fixed an upright spindle S*s*, which passes through the vessel, and about which it may be turned in any direction at pleasure; D is a brass plate fixed on the deck of the vessel, and divided according to the points of the compass, the north and south points being fore and aft. H is a hand, or index, moveable on the spindle; C is the compass, P the correcting plate, and R the rod by which it is attached to the pedestal of the compass. The dotted line passing obliquely downwards from C is that in which the centre of attraction of all the guns, and of the other articles of iron contained in the model, falls; and in this line the centre of attraction of the plate P is also situated, and at such a distance from C, that its power on the needle is equal to that of all the other iron at a greater distance in the same time. Now, to illustrate the nature of the correction by the model, turn it about on its pivot, till the compass shews north, that is, till the lubber-line in the brass compass-box and the north of the card coincide: the vessel is then in the meridian, and the moveable index on deck must be set also to point north.

Turn now the vessel on its spindle, till the hand is directed to any other point (as, for example, east): then, if there were no attraction from the iron on board, the compass would shew east also; but it will be found to point about E. ½ N., which shews the attraction at that point to be about 5½ deg.; and in the same way the attraction at any other point may be observed, the plate during such time being removed; and if at any of those points the plate be applied, it will be found to double the quantity of the error.

To illustrate its application in real practice, turn the vessel about (having first adjusted it), till the apparent course, by compass, is east, or any other proposed point, without regarding the index on deck; and now, to find the true course, apply the plate, and observe how many degrees, &c. it attracts the needle, which in the model, at east, will be found about half a point; so that the apparent course, by compass, will be now E ½ N., the attraction of the plate having drawn the north end forward about 5½ deg. or a half point. The iron of the vessel had therefore done the same before the plate was applied; consequently, the true course was E ½ S.; and by looking to the index on deck, it will be found that this is actually the course shewn. The same will be the case at any other point, except that the quantity of attraction will be different, being most at those points towards the east and west, and less as we approach the meridian. In other parts of the world, however, the east and west will be the points of least attraction, and the greatest will be at the N. E., N.W., S. E., and S.W.; but still the plate will always continue to give the same attraction as the vessel, and will therefore in all places furnish a ready method of correction.

The accurate action of a model is seldom to be expected, and less perhaps in magnetical experiments than in any others. I was therefore very agreeably surprised to find how very correctly this model answered all the conditions which I had found to obtain in the largest vessels.

It will be seen in the summary given in Note 1, that the

power of attraction, or rather the tangent of the angle of deviation, at different distances, is reciprocally as the cube of those distances and that the tangents of the angles of deviation; are also proportional (directly) as the cube of the like linear dimensions of similar masses: if, therefore, (as in the model,) the magnitudes of the masses are proportional to the general dimensions, the deviations ought to be analogous, and even equal to those in a vessel at large; and a few experiments on the model will shew that this is not merely the case theoretically, but that practically the agreement is much closer than could possibly be anticipated.

XXXI.—*On the Importance of Practical Information. In a Letter from a Correspondent.*

SIR, *North Walsham, Norfolk, Jan.* 24, 1822.

I HAVE taken your First Number of the Technical Repository, and continue to take it. Such a work was very much wanted, especially in the country; where, if a gentleman employs a mechanic for any purpose at all out of the daily routine of his business, he must, in general, not only superintend him, but think for him. And how many thousands of country gentlemen are quite unqualified for such a task!

My object in addressing you, at present, is, not to find fault with your work, but to suggest what I am very sure would be an improvement; I mean, not in point of originality, but of utility. Now, as *utility* is professedly the object of all the manual arts and operations, I hope you will not find my suggestion unworthy of your attention. In the remote parts of the country, we do not so much want to be told of *new* inventions (yet we wish for them too, but not so much) as good and economical methods of performing *old* operations—operations which, although well understood perhaps by you, and practical men like you, yet are either wholly forgotten, or but superficially

known and imperfectly practised in retired parts of the country.

What I would therefore recommend to you, is, to devote a portion, small or large as you may estimate its importance and its necessity, to such by-gone discoveries and inventions as may be calculated to enlarge the sphere of our comforts, and enable the secluded country gentleman to discharge the office which I have before said it is frequently necessary for him to undertake: and also, to furnish the country artisan with principles and plain directions for their application. I wish for the *principles*, along with the directions, that the latter may not be used; as I found my bricklayer, the other day, employing a problem in Euclid. He wanted to set out a *right angle*; and, to effect this, he connected two tiling laths by a nail through their extremities: he then measured off three feet from the one, and four feet from the other end, thus attached; and when this was done, he opened the legs so marked till the marks were five feet asunder. This, he told me, he was sure formed them into a right angle; but the only reason he could give *why* it was so, was, that when he was apprentice his master had taught him so.

Now, of the commonest principles of Hydraulics, and of all machines for raising water, we countrymen are sadly ignorant. Again, we know neither the best modes of warming either our apartments or our hot-houses; or of conveying heat, at all, by flues or pipes: and it has frequently struck me, that a poor fellow, on the coast near me, might save himself the labour and expense of a horse, in raising salt water from the sea, to his baths at the top of the cliff, by the Hydraulic Ram, to be wrought by the rush of the tide. In fact, air, fire and water, and all their modifications, so useful as agents in scientific hands, are of very little more use to us than they were to Adam.

I think, then, that your work may be made of infinite utility, in disseminating a knowledge of a thousand things which you know, and we do not; but which are highly

expedient to be known by all who study either comfort or accommodation. I am, Sir,

Your very obedient Servant,

T———s G——E.

We have inserted this letter from our valued Correspondent in Norfolk, in order to shew how exactly his ideas coincide with our own.—And, indeed, we must confess that we do not attach much importance to a thing, merely because it is *new*. For it is obvious, that many *new* patents, for instance, are continually taken out, either for *old* inventions, or for *utterly impracticable* or *useless* things: we shall not mention any in particular, but leave them for the good sense of our readers to discover.

It probably behoves us here to repeat what are the peculiar features of our work. And, First, in regard to patents—we shall generally prefer those *useful patented inventions*, which are become, through lapse of time, the property of the public; and which, consequently, the public can enjoy, without the interference of any one: such, for instance, as the valuable discoveries of the late Mr. Nicolas Paul, which formed part of our First Number, are continued in this, and will constitute parts of other Numbers, until the whole are laid before the public.—We shall also publish those *useful patented inventions*, which, although not yet the public property, are, owing either to the death of the inventors, or the want of proper encouragement from the public, lying dormant, to the great injury of society; such as the late Mr. Sheffield's, just published by us; and others now before us.—We shall also be glad to communicate *fully* to the public, any *new patent* which comes under our *necessary limitation* of USEFULNESS; and to display its merits, both in description, and by engravings, to the best of our abilities.

Secondly, We shall constantly prefer, to others of a doubtful character, those *practical inventions* which appear likely to realize the expectations of their inventors; and, particularly, the inventions published in the Annual Volumes

of the Transactions of the Society for the Encouragement of Arts, &c. &c.; which inventions must previously have been submitted to, and approved of, by those Committees in the Society best qualified to judge thereof; and afterwards, having received the approbation of the Society itself, deserve the confidence of the public. Also such inventions and processes as are practically known to the Editor himself, or such as evidently bear tokens of their *practical utility*.

We sincerely wish that the elements of Geometry, as well as of the other useful sciences, were more generally understood amongst workmen: they would not then be reduced to the necessity of performing *empirically*, and as stated by our Correspondent, those operations, which they are unable *satisfactorily* to account for. Had the bricklayer, for instance, known that law of all right-angled triangles,—viz. that the sum of the squares of their sides must be equal to the squares of their hypothenuses,—he would have been enabled to account *theoretically* for the method he employed *.

We are glad to find that our Scottish fellow-countrymen are likely to be benefitted by the diffusion of this necessary knowledge amongst them; as will appear from Article XXXIII. in our present Number: and we sincerely wish that similar institutions were to be established more generally in the civilized world. Until then, and until the *errors*, which more or less abound in most of our publications on the *useful arts*, are *detected* and *exposed*, the public must suffer the consequences of the general ignorance on the most important objects which prevails amongst us.

* Travellers have been surprised at the superior intelligence of the Mechanics of Geneva, even of the lower orders; but the wonder ceases, on learning that the poorest there receive an excellent public education. In England, on the contrary, we have frequently to witness the neglect of our public schools; and to see boys idly employed for six or seven years, in learning to read and write very badly, and in obtaining merely an imperfect knowledge of the first rules of arithmetic.

Scotland, however, by better attention to the appointment of the schoolmasters, furnishes a better education to her lower classes (See the laudable remark of her new *Society of Arts*, in p. 192 of this Number); and has justly to boast of supplying the far greater number of scientific Mechanics, not only to the United Kingdom, but to the world generally.

We shall instance, in particular, the *great errors* which almost universally prevail, both in this country and upon the Continent, in regard to the shapes given to the teeth of wheels, pinions, and racks,—those important movements, which are more or less employed in all machines; as also in regard to the construction of the pivots or axles upon which they revolve. In consequence of such erroneous constructions, an useless and mischievous expenditure of the labour of the men or the animals employed in giving motion to these machines,—or of the powers, as of steam, water, wind, &c. by which they are actuated,—takes place, in wearing out the teeth of the wheels, &c. and their axles; instead of being beneficially employed in performing the work for which the machines were constructed.

The Editor has already given to the world, many years since, in a popular work*, the result of much experience, in regard to the proper forms of the teeth of wheels, pinions, racks, &c.: which he intends to enlarge upon, and to extend to the other parts of machinery, in the future Numbers of this Work.

XXXII.—*On Warming and Ventilating Rooms. By* Jacob Perkins, *Esq.*†

This improvement, in its simplest form, consists in introducing a large column of cold air immediately at the back of the stove (which may be a common German stove), by which means the heat from the stove is rapidly carried off. The greater the quantity of air which is made to strike against, and pass by the stove, the greater is the quantity of heat given out by it. This kind of stove will not work to good advantage when the room is air-tight: to remedy this evil, an aperture should be made near the ceiling. But where there is a chimney-draught in the room, opposite

* Imison's Elements of Science and Art.

† From Vols. xxxviii. and xxxix. of the Transactions of the Society of Arts, &c. &c.—The large Silver Medal was voted to Mr. Perkins.

the stove, the effect is very much increased; especially if a small fire be kept up in the chimney of that room. This constant current of warm air ventilates rooms perfectly, and renders them pleasant and wholesome. It has also been found, that the air is very much improved by having a vessel of water placed on the top of the stove, so that evaporation may be constantly going on.

Reference to the Engraving of Mr. JACOB PERKINS's *Warming and Ventilating Stove. Plate* XIV.

Fig. 1, Front view of the stove.

Fig. 2, Side view of ditto.

Fig. 3, Plan of ditto.

a a a, The body of the stove.

b b b, A sheet of iron affixed to the air-conductor, embracing two-thirds the diameter of the stove; and extending from top to bottom, having a space of two inches between it and the stove,

o o o, The air-conductor, being about the same diameter as the stove. It is also attached to the sheet of iron *b*.

d, The wall into which the air-conductor is fixed.

e e e, A cup to be supplied with water from time to time, as the former portion evaporates.—This invention is now employed with great success in several parts of the metropolis. Mr. Perkins has, however, since extended its advantages very considerably, by causing the air introduced by the horizontal air-trunk to strike upon an improved stove, which enables the operator to produce, at pleasure, an ascending or descending draught through the fuel, by means of the latter of which the smoke is wholly consumed. The chimney of the stove is also surrounded by a vertical air-trunk, fitted with valves in the proper places; by means of which the heated air may be distributed at pleasure to one or more upper floors.

This plan, which theoretically appears very sound, has been carried into practice, on a large scale, with perfect success, at a printing-office, in the Old Bailey, in the occu-

pation of Mr. T. C. Hansard, where the ordinary means of producing the required heat, by two fires in each room, had proved insufficient*.

The moderate original cost of the apparatus, the considerable saving in fuel, and its very general applicability to shops and drying-houses of every description, must be obvious to every one.

Reference to the Engraving of Mr. JACOB PERKINS'S *improved Warming and Ventilating Stove. Plate* XIV.

Fig. 4, section of the stove; *i*, the mouth in which the fuel is put: *k*, the lid to shut it; *l*, the grating hinged at the back, and held up in front by the iron button *m*; *n*, the ash-pit, which is quite close, all but the opening *o*: this is opened, and the lid *k* shut, while lighting the fire; but when this is done, and the flue *p p* has become warm enough to produce a draught, the opening *o* is shut, and the lid *k* opened, more or less, to supply or regulate the draught, by which means the smoke is effectually consumed; the lower part of the flue *p* is spread out at bottom nearly as wide as the stove (as seen in the Plan, fig. 5); *q q* is an air-trunk, supplying fresh air from the outside of the house; this is directed by an iron screen *r r*, so as to impinge on the flue and stove, and become effectually warmed as it passes in; *s s* is a hood or trunk surrounding the flue; this draws in much of the fresh air, and conducts it, still hot, through the ceiling, into the next floor, by the opening *t*, as shewn by the arrows: above this opening is a register *v*, to stop the air from continuing its course to the third floor; or, if there is too much in the second, to let a portion escape to the third floor (a bird's-eye view, fig. 6, shews this register partly open): when the

* Mr. Hansard has since extended its advantages, by removing it from the first-floor to the ground-floor of his premises; so that it now completely warms and ventilates *four* stories, instead of *three* only, as at first, and as described in the text;—a third air-trunk, similar to that shewn at *u*, in the Plate, being all the addition necessary to be made thereto.

Mr. H. is now about establishing another printing-office; and intends to convert the upper story into a drying-loft, and to lessen the height of the press- and compositors' rooms accordingly.—EDITOR.

register *v* is closed, another current of fresh air comes in from without, through a second air-trunk *u*, and, continuing its ascent, comes out warmed at *s s*, fig. 7, into the third floor: *w w*, fig. 4, is the floor of the second room; and *x x*, fig. 7, the third room floor: *y* is a grating or partial damper; it prevents the passage of lighted shavings or paper into the chimney, and is shewn separate, fig. 8: *z z*, an iron plate, through which the elbow passes into the chimney; there is an opening in the elbow, with a sliding cover: *a a*, figs. 4 and 7, are hooks of iron rod, to bear the weight of the trunk *s s*.

XXXIII.—*Society of Arts for Scotland.**

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* This Article was received too late for insertion in our February Number.

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It has long been a matter of surprise, as well as of regret, that Scotland should be almost the only country in Europe in which there was no general Institution for promoting the Useful Arts. The advanced state of education among the working-classes, and the habits of reading and reflection which elevate that portion of our countrymen above those of all other nations, have called forth powers of invention which have hitherto been allowed to languish in obscurity and neglect. During the commotions which recently agitated Europe, the Arts and Manufactures of Great Britain enjoyed an indirect patronage, in consequence of their decline in other countries: but the restoration of peace has withdrawn that casual protection; and from the vigour with which the rival arts and industry of foreign states have been revived*, it is too obvious that the superiority of our own can only be sustained by the most liberal and efficacious excitement of mechanical talent.

In order to assist in the promotion of this desirable purpose, a SOCIETY OF ARTS has been for some years projected in this metropolis, and was first announced to the public in December 1819, under the name of a "Society for the Promotion of the Mechanical and Useful Arts in Scotland, for rewarding Inventions of Public Utility, and disseminating useful Knowledge among the industrious Classes of Society." The object of this Institution, is to encourage the mechanical and chemical arts, by awarding prizes, either in the form of money or honorary medals, to the authors of useful inventions or valuable processes;—by assisting inventors in securing the just advantages of their labours;—by performing useful experiments, or making trials of machinery, when the inventors themselves have not the means of carrying their ideas into effect;—by depositing models of new inventions and interesting machines in a Hall erected for that purpose;—and by

* See the Notice of *the Rhenish West-India Company*, in the Miscellaneous Article of our present Number.—EDITOR.

disseminating useful knowledge among the industrious classes of society.

In accomplishing the last of these objects, it is proposed to adopt a general plan for Scotland; and after arranging a proper system of instruction, and selecting the best qualified persons for putting it in execution, the Society will watch over the progress of the local establishments, with that care and attention which their nature and importance so particularly require. The success which has attended the experiment of a School of Arts for Edinburgh, affords the best earnest of the advantages which would result from similar establishments in the principal towns in Scotland.

By thus giving importance to the labours of manufacturing industry, and pointing out the honours and advantages to which superiority of mechanical genius so often leads, we may expect to improve the actual condition of the working classes;—to withdraw them from those political and metaphysical speculations, which too often interrupt their habits of industry and subordination;—and to give a fresh impulse to valuable talents, which, when well directed, may promote not only the happiness of their possessor, but augment the resources of the country, and advance the interests of general civilization.

The funds of the Institution will be derived principally from an annual subscription of *One Guinea* from each of its Members, or a composition of *Ten Guineas* in lieu of annual subscriptions; but donations, however small, will be received, and will be particularly expected from those classes who are likely to derive the most immediate benefit from such an Institution. There is, besides, reason to expect, that the trustees on the late Mr. Keith's legacy to science will, in conformity with the wishes of Mr. Keith, by whom the plan of this Institution was especially approved, appropriate a considerable sum to the establishment of Annual Prizes*.

* "The industry and emulation of the students," says Mr. Coxe, in reference to the advantages of the Public Academy at Geneva, "are excited by the *annual distribution of prizes* to those who distinguish themselves

Although the Society of Arts must necessarily hold its meetings in Edinburgh, as the metropolis of the kingdom, yet, as its benefits will extend to every part of Scotland, it is hoped that the landed proprietors, and the opulent manufacturers and tradesmen of every county, will come forward in support of so useful an Institution; and, in order to facilitate the transmission of inventions to the Society, Corresponding Committees will be established in Glasgow, Aberdeen, Perth, and Inverness. From the city of Glasgow the Society looks forward to much assistance, not only in promoting its general interests, but in carrying through its scientific objects; and there can be no doubt but that this great and manufacturing city will reap the first-fruits of an Institution for the advancement of the useful arts.

The Members of the Society will have free admission for themselves and their families to the Hall of Models; and will be entitled to attend at all exhibitions of machinery, and to witness all experiments made under the authority of the Institution.

It is proposed, that the affairs of the Society shall be conducted, for some years, by the present Office-bearers and Councillors; and that a general meeting of Members shall be held, for making such permanent regulations as may seem necessary for the future government of the Institution.

Edinburgh, June 29th, 1821.

We sincerely congratulate our Northern fellow-countrymen, on the probability of their having so truly respectable

themselves in each class. The prizes consist of small medals, but are conferred with such solemnity as cannot fail to produce a striking effect on the minds of youth."

A Correspondent, in a late tour through the Netherlands, informed us of an highly interesting scene which he witnessed at Ostend. A young man, a native of Ostend, having obtained a prize in the Academy of Painting at Ghent or Brussels, was, on his return home, met at some distance from the town by a procession consisting of the Prefet and Municipality; who conducting him to the Hotel de Ville, publickly congratuled and encouraged him in his praiseworthy career.—EDITOR.

an Institution, as the above, established amongst them; and we trust that it will make good the expectations of its founders, in promoting the useful arts in Scotland.

At the same time, we must confess that we are not a little disappointed, in finding its constitution *so very unlike* that of "*The Society for the Encouragement of* ARTS, MANUFACTURES, *and* COMMERCE *of* LONDON;" in which Society, all its officers, both honorary and salaried, owe their situations entirely to the good opinion entertained of their respective merits and services by the Members of the Society, and as expressed by their votes at its annual election: and every Member thereof has a right to be present at, and to vote in, all the meetings of the Society. Whereas, on the contrary, the concluding paragraph of this communication proposes, "*That the affairs of the Society shall be conducted, for some years, by the present Office-bearers and Councillors!*"

We hope, however, notwithstanding the opportunity which may be thus afforded to the officers of this Society, of forwarding their own private interest in preference to that of the public, yet that their good sense and a spirit of patriotism will induce them to act so as to merit the patronage of His Majesty and the public:—and then, and not till then, the Institution may be expected to flourish, and to enjoy the confidence and approbation of the civilized world, in an equal degree with its prototype in the British metropolis.

XXXIV.—*On* SIDEROGRAPHY; *or, the Art of Engraving upon Cast Steel; of Decarbonating it; Carbonating it; and Hardening and Tempering it. By Messrs.* PERKINS, FAIRMAN, *and* HEATH *.

THE Society for the Encouragement of Arts, Manufactures, and Commerce having devoted so much of their valuable time to investigate the different methods proposed for the prevention of the forgery of Bank Notes, we, the

* From Vol. XXXVIII. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

proprietors of the Siderographic art, believe that a full account of our plan (which has been in successful operation many years in America, and is now adopted by many banks in this country) will not be thought unworthy of their attention.

We will, in the first place, state what we consider to be the grand basis of *security* in this plan; and, secondly, the means of executing it. Although it is certainly not a new idea, that the greatest security which could possibly be afforded in preventing forgery would be that of employing a combination of the talents of the first-rate artists in fabricating a bank-note plate, and of having the notes always *identically* the same; yet we conceive the following plan to effect this object is entirely new: it is the power of re-producing and multiplying the works of the greatest artists which constitutes the strength of this system; it is the basis on which we build our hopes. The method of multiplying engravings is as follows:

A steel plate (the method of preparing which will be hereafter described) is engraved or etched in the usual way: it is then hardened. A cylinder of very soft steel, of from 2 to 3 inches in diameter, is made to roll backwards and forwards on the surface of the steel plate, until the whole of the impression from the engraving is seen on the cylinder in alto-relievo: after this cylinder has been hardened, it is made to roll backwards and forwards on a copper or soft-steel plate, and a perfect fac-simile of the original is produced of equal sharpness. The following calculations will shew to what extent this system of preventing forgery may be carried.

Suppose 20 of the best historical and other engravers were employed, each to engrave a vignette, each vignette to occupy 4 square inches, and each artist to expend 6 months on his vignette: let these 20 vignettes be transferred to two steel plates, one for the front of the note, and the other for the back; the result will be, that one man (could such an one be found) would be occupied 10 years, or 20 men six months, to produce a note of equal goodness.

Is it possible to suppose any thing better can be adopted, than to make it unprofitable to be engaged in such business? If a bank-note plate can be made to cost 10,000*l.* (which would be the case, if 20 artists, whose time would be worth 1000*l.* per annum, were engaged 6 months each), would it not be much less likely to be imitated than one that would cost but 5*l.* or 10*l.*? If a bank plate can be made to contain the work of 20 of the best artists in the world, could another plate of equal goodness be made without employing the same artists? It is hardly to be presumed that 20 such artists would be engaged in making a spurious note; but admitting it possible, it would not be a fac-simile, and might be easily distinguished from the true note, by any one acquainted with the original. One of the peculiar features of this invention is, that any one may be furnished with a perfect fac-simile of the whole or of any part of the original note; which will serve to identify the note, if good: this is owing to the infinite number of impressions that may be obtained from the original engraving. Having shewn that a plate may be made to cost 10,000*l.* we will undertake to prove that it is not incompatible with economy. To shew the economy of this plan in its best light, we must be allowed to apply it to the best advantage, which would be by its being adopted by a bank whose daily consumption is not less than 25,000 notes.

Suppose the first steel plate cost 10,000*l.*, the next 999 plates will only cost 10,000*l.*: then 1000 steel plates will amount to 20,000*l.* Each steel plate will print at least 150,000 impressions: of course, 1000 plates would furnish 150,000,000 of impressions, which is the number that would be wanted in 20 years, at 25,000 impressions per day. Now, the cost of impressions from steel plates would be (where the above number is wanted) one penny for $31\frac{1}{4}$ impressions; whereas, if copper-plates were used, which cost only 3*l.* each plate, the number of impressions for a penny would be but $8\frac{1}{3}$, since a copper-plate prints but 6000 impressions before it is worn out.

Another very important consideration is, that steel plates admit of an improved method of printing, and, when worked to the greatest advantage, will make a saving of 50 per cent.: this saving in 20 years in printing the above number of notes would be 75,000 *l.* which would not only pay the whole cost of making the plates, but leave a balance of 55,000 *l.*

The system of making plates and of printing, will apply equally well to that of ornamenting standard works, particularly bibles, prayer-books, primers, catechisms, spelling-books, and works of natural history and philosophy. In proportion to the number wanted, will be the advantage of adopting this plan. It is often the case in this country, that from 4 to 6 copper-plates are worn out in one edition, and not half the impressions perfect. A hardened steel-plate will print more *proof impressions* than the above number of copper-plates can furnish, even of common impressions. This fact is demonstrated by the two impressions from the same plate, which accompany this communication: of which one is of the first impression taken from it, and the other was printed after 35,000 had been taken from it *.

This plate will also shew the practicability of identity. The four medallions, by inspection, will be found to be perfectly the same, *line for line and dot for dot.* By examining the machine engraving, particularly the chain; the two *styles* of work, viz. copper-plate and letter-press printing, will be seen beautifully combined. This is effected by the process of transferring and re-transferring. This kind of engraving is extremely difficult to imitate. This machine, which is denominated the geometrical lathe, was invented, in America, by Mr. Asa Spencer. Its powers for producing variety are equalled only by the kaleidoscope; but for beautiful patterns it surpasses every thing of the kind. It has one of the peculiarities of the kaleidoscope, viz. that the turning of a screw, like the turning of the

* We regret that we have not the means of affording impressions from this plate. But we can state, that no sensible difference could be perceived in the two impressions.—EDITOR.

kaleidoscope, produces an entire new pattern, which was never before seen, and perhaps would never be seen again. This pattern, however, may be perpetuated by the transferring process. We are now printing from a plate of the most delicate work, which has already printed above 100,000 impressions, and is yet sound. We cannot yet say how long a well-hardened steel-plate will last, having never printed more than 500,000 impressions from the same plate: it should, however, be observed, that this plate consisted principally of writing, or work quite as strong. It may also be observed, that the impressions are yet good. The manufacture of printed calicoes, ribbons, &c., as well as of earthenware, may be much improved by adopting this system; and we are happy to say that experiments are soon to be made thereof. This improvement in engraving will apply to about one quarter of the present number of plates used. The others must necessarily be of copper, as a sufficient number of impressions would not be wanted to defray the expense of a steel-plate. Not less than a number of impressions which would wear out three copper-plates would warrant the making a steel-plate. But such is the number of subjects to which this art will apply, and the great inducement to publishers to embellish their works, where large editions are wanted, which they now can do in consequence of its economy, that, instead of the demand of engravers being lessened, it will be very much enhanced.

The use of fine and delicate engraving for bank-notes has been objected to, in consequence of the difficulty of printing on such highly-sized paper. But this objection is entirely got over, by our method of printing in the water leaf, and sizing after printing. This improvement has a triple advantage,—that of producing beautiful impressions, having on its surface, after printing, a better size, and preventing the ink from being so easily transferred.

In order to describe the method of preparing and hardening the steel-plate and dies, the following particulars are necessary:

In order to decarbonate the surfaces of cast-steel plates, cylinders, or dies, by which they are rendered much softer and fitter for receiving either transferred or engraved designs, we use pure iron filings, divested of all foreign or extraneous matters.

The stratum of decarbonated steel should not be too thick for transferring fine and delicate engravings; for instance, not more than three times the depth of the engraving: but for other purposes, the surface of the steel may be decarbonated to any required thickness.

To decarbonate it to a proper thickness for fine engravings, it is to be exposed for four hours in a white heat, inclosed in a cast-iron box, with a well-closed lid. The sides of the cast-iron box are made at least three quarters of an inch in thickness; and at least a thickness of half an inch of pure iron filings should cover or surround the cast-steel surface to be decarbonated. The box is to be suffered to cool very slowly; which may be effected by shutting off all access of air to the furnace, and covering it with a layer six or seven inches in thickness, of fine cinders. Each side of the steel-plate, cylinder, or die, must be equally decarbonated, to prevent it from springing or warping in hardening. It is also found, that the safest way to heat the plates, cylinders, or dies, is by placing them in a vertical position.

The best cast-steel is preferred to any other sort of steel, for the purpose of making plates, cylinders, circular or other dies; and more especially, when such plates, cylinders, or dies are intended to be decarbonated. For the reason given above, the steel is decarbonated, solely for the purpose of rendering it sufficiently soft for receiving any impression intended to be made thereon: it is therefore necessary, that, after any piece of steel has been so decarbonated, whether it be in the shape of a plate, or a cylinder, or a die, it should, previously to being printed from, be again carbonated, or re-converted into steel capable of being hardened. In order, therefore, to effect this carbonization or re-conversion into steel, the following

process is employed:—a suitable quantity of leather is to be converted into charcoal, by the well-known method of exposing it to a red heat in an iron retort, for a sufficient length of time, or until most of the evaporable matter is driven off from the leather. Having thus prepared the charcoal, it is reduced to a very fine powder; then take a box made of cast-iron, of sufficient dimensions to receive the plate, cylinder, or die, which is to be re-converted into steel, so as that the intermediate space between the sides of the said box, and the plate, cylinder, or die, may be about one inch. This box is to be filled with the powdered charcoal, and, having covered it with a well-fitted lid, let it be placed in a furnace similar to those used for melting brass; when the heat must be gradually increased, until the box is somewhat above a red heat: it must be suffered to remain in that state till all the evaporable matter is driven off from the charcoal. Then remove the lid from the box, and immerse the plate, cylinder, or die, into the powdered charcoal; taking care to place it as nearly in the middle as possible, so that it may be surrounded on all sides by a stratum of the powder, of nearly an uniform thickness. The lid being replaced, the box, with the plate, cylinder, or die, must remain in the degree of heat before described, from three to five hours, according to the thickness of the plate, cylinder, or die so exposed. Three hours are sufficient for a plate of half an inch in thickness; and five hours when the steel is one inch and a half in thickness. After the plate, cylinder, or die has been thus exposed to the fire for a sufficient length of time, take it from the box, and immediately plunge it into cold water. It is important here to observe, that it is found, by experience, that the plates, or other pieces of steel, when plunged into cold water, are least liable to be warped or bent when they are held in a vertical position, or made to enter the water in the direction of their length. If a piece of steel, heated to a proper degree for hardening, be plunged into water, and suffered to remain there until it becomes cold, it is found by experience to be very liable to

crack or break; and, in many cases, it would be found too hard for the operations it was intended to perform. If the steel cracks or breaks, it is spoiled. In order to render it fit for use, should it happen not to be broken in the hardening, it is the common practice to heat the steel again, in order to reduce or lower its temper, as it is technically called. The degree of heat to which it is now exposed determines the future degree of hardness, or the temper; and this is indicated by a change of colour upon the surface of the steel. During this heating, a succession of shades is produced, from a very pale straw colour to a deep blue. It is found, however, by long experience, that on plunging the heated steel into cold water, and suffering it to remain there no longer than is sufficient for lowering the temperature of the steel to the same degree as that to which a hard piece of steel must have been raised, in order to temper it in the common way; it not only produces the same degree of hardness in the steel, but, what is of much more importance, almost entirely does away the risk or liability of its cracking or breaking. It is impossible to communicate by words, or to describe the criterion by which we can judge of, or determine, when the steel has arrived at the proper degree of temperature, after being plunged into cold water; it can only be learned by actual observation, as the workman must be guided entirely by the kind of hissing or singing noise which the heated steel produces in the water while cooling. From the moment of its being first plunged into the water, a varying sound will be observed; and it is at a certain tone before the noise ceases, that the effect to be produced is known. The only directions which can be given, whereby the experimentalist can be benefitted, are as follow; namely, to take a piece of steel which has already been hardened by remaining in the water till cold; and, by the common method of again heating it, to let it be brought to the pale yellow, or straw colour, which indicates the desired temper of the steel-plate to be hardened by the above process: as soon as he discovers this colour to be produced, to dip the steel into

water, and attend carefully to the hissing, or, as some call it, singing noise, which it occasions; he will then be better able, and with fewer experiments, to judge of the precise time at which the steel should be taken out. It is not meant to be understood that the temper indicated by a straw colour, is that to which the steel-plate, cylinder, or die, should be ultimately reduced; because it would then be found too hard; but merely that the temperature which would produce that colour, is that by which the peculiar sound would be occasioned when the steel should be withdrawn from the water for the first time. Immediately on withdrawing it from the water, the steel-plate, cylinder, or die, must be laid upon or held over a fire, and heated uniformly, until its temperature is raised to that degree at which tallow would be decomposed; or, in other words, until smoke is perceived to arise from the surface of the steel-plate, cylinder, or die, after having been rubbed with tallow. The steel-plate, cylinder, or die, must then be again plunged into water, and kept there until the sound becomes somewhat weaker than before. It is then to be taken out, and heated a second time to the same degree, by the same rule of smoking tallow as before; and the third time plunged into water, till the sound becomes again weaker than the last. Expose it a third time to the fire as before; and, for the last time, return it into the water and cool it: after it is cooled, clean the surface of the steel-plate, cylinder, or die; and by heating it over the fire, the temper must be finally reduced by bringing on a brown, or such other lighter or darker shade of colour, as may best suit the quality of the steel, or the purpose to which it is to be applied*.

* Mr. Charles Warren, an eminent historical engraver, has adopted, in part, this valuable process, with very considerable advantage. Instead of making his plates as thick as Mr. Perkins does, he merely decarbonates Pit-saw cast-steel, and forms his plates thereof; and, after grinding and polishing the surface of the plate, executes his engraving. He does not then carbonate and harden it; but leaves it in its softened state: which, however, he finds fully sufficient for his purpose, as it will afford an infinitely greater number of impressions than a copper-plate; and the ink is wiped off its surface with far greater facility.—Editor.

XXXV.—*On* Professor Gibson's *Self-acting Circular Saw, and Mr.* Thomas Machell's *Annular Saw. By the* Editor.

We promised, in our last Number, to endeavour to afford our readers the information necessary to enable English mechanicians and surgeons'-instrument-makers to render these valuable saws *self-acting*. And, with respect to the first, we believe it will only be necessary to make the wheel which Professor Gibson mentions,—what is termed a "toothed-bevel," or "mitre-wheel;" and to affix, to both ends of the connecting-rod, bevel-pinions; the one to work into the bevel-wheel above mentioned, and the other to work into the bevel-pinion on the axis of the circular-saw. The remaining parts of the mechanism are sufficiently described by the Professor, to enable any competent workman to construct the instrument.

With regard to Mr. Machell's *Annular Saw*, we fear it will be difficult to make our readers understand the construction of the saw itself, without an engraving; but which we hope soon to have an opportunity of affording, in consequence of the probability of a *Self-acting Annular Saw* being shortly to be constructed for an eminent surgeon in this metropolis; when we shall not fail to cause an accurate drawing of it to be executed, and an engraving made therefrom. In the mean time, we shall state, that the *Annular Saw* consists of a flat steel ring, with saw-teeth made around it; having, also, equi-distant interstices, into which a toothed-wheel works, by which the *Annular Saw* is driven. There is not, however, as Professor Gibson apprehends, any likelihood of the saw-teeth being injured in use, owing to the manner in which they are formed. The inside of the ring is hollowed, like a spectacle-frame; and it turns upon the rounded edge of a steel plate, which is made at first sufficiently small to enter the ring; and afterwards bulged out, by driving a taper mandrel into a hole made in the centre of the plate, until

it becomes large enough to fill the hollow made in the ring; not, however, so tightly as to prevent the ring from turning upon it. The ring thus fits upon the rounded edge of the plate, very much similar to a spectacle-glass in its rim. The plate and the ring are both made of an equal thickness; and the plate is affixed to the saw-frame, or carriage, by screws, passing into holes made as near to the joining of the plate and ring as may be: and thus, the saw will literally cut beyond its semi-diameter; the plate being substituted for the usual axis of circular saws.

We fear that we have scarcely made ourselves intelligible, in our description of the construction of the *Annular Saw*. But, supposing it to be understood, it is evident that the very same movement by which Professor Gibson's Circular Saw is actuated, is equally applicable to the *Annular Saw*; all that is wanted, being the addition of a bevel-pinion, fixed upon the same arbor with the toothed-wheel above described as actuating the saw. Mr. Machell was rewarded for this invention by the Society of Arts, several years since, with the larger gold medal; it being *their highest honorary reward*: and a description and engraving of it were published in their Annual Volume of Transactions. The construction of its carriage has, however, subsequently received so much improvement, both from its inventor and from Sir Astley Cooper, that it would now be of little consequence to re-publish that description of it; and the more especially, as we so soon hope to be enabled to give it in its still more perfected form.

Schoose-Farm buildings, and within less than half a mile of the town of Workington.

I was still further excited by the daily and hourly applications for labour; arising, I fear, from the decreased and decreasing capital of the farmer.

The scale of labour has annually been declining, which cannot but be a matter of deep regret to every friend to the country.

The nation has witnessed scenes of great distress during the years of scarcity; but these bore no comparison to the present times.

The hope of the privations being temporary, gave courage to bear up against them: but now the future has nothing to invigorate exertion, or inspire fortitude. Numbers are daily forced into the ranks of pauperism, against their will. Industrious habits are destroyed, and, with them, that providence and forethought which is the basis of the happiness and respectability of the working-classes. In order, not only to continue in employment the usual hands, but to extend it to the employing of others, at a season when the active labours of the year are nearly closed, I determined on undertaking the re-drainage of Walriggs, a field of eighty acres, which had been drained about 18 years before, in a manner then considered to be effectual.

The main-drains, as far as they go, were well done, and these have been made available in many instances in the present drainage. They all run into the ditches which surround the whole, from which there is a considerable fall on every side of the field. The collateral drains were only twenty inches deep, set with three stones, in the form of a triangle, having about eight inches of cover upon the top. A drain of 20 inches was then thought to be sufficient; and all that was aimed at, was to cut off the springs, no regard being paid to carry off the rain-water, which is so injurious to clay land.

Subsequent experience has shewn, that, in most instances, the stratum which holds the water is at so great a depth,

as to be below the bottom of such shallow drains; that, to do the work effectually, the drain must reach the stratum where the wet rests.

The importance of deep ploughing was not heretofore known, or provided for.

Five years ago, this field was deep ploughed: it had been foreseen, that in many instances the plough was likely to come in contact with the head of the drains: this did happen; and the consequence has been, to render the land as wet, or nearly so, as it was before any thing was done to it.

Fifty out of the eighty acres were greatly injured by water. The annexed plan * will point out the manner in which the work has been executed. It was commenced in November, and was finished the second week in January.

The cutting was let, as it requires practice to keep the drain the exact width. Bad hands are apt to increase the dimensions, and thereby greatly augment the expense of filling, which is the expensive part of draining. Gathering and getting stones was done by the day, and employed a number of women and children, besides the persons occupied in the quarries, which were fortunately near at hand. The depth of the drains is from 3½ feet to four feet: the breadth, twenty inches at the top, and twelve inches at the bottom. The drains have a cavity at the bottom, of six inches; being set with two side-stones and a cover, and then filled with stones to the top; the six inches next the top being filled with small stones, that, in case the plough should strike into them, no injury is done to the drain. The drains are thus filled to within ten inches of the surface. It required a solid yard of stone to fill a rod of seven yards; in weight, above two tons.

To furnish such an enormous quantity of stones as eight hundred and fifty-nine rods required, was an undertaking of no small difficulty; and could not have been executed in the time, had not other substitutes been found. In coal countries, there are strata known by the name of sill or

* The plan is not published in the Society's Transactions.—EDITOR.

schistus, and rattler, which is a mixture of coal and schistus. Sill is a substance that will not bear exposure to the atmosphere; but rattler does not fall, and is very light in comparison to its bulk.

Recourse was had to these substances, and many hundred cart-loads of both were collected from the coal-banks; the remainder was gathered from the ground, and obtained from the quarries.

	s.	*d.*	
The cutting, filling, and setting, was	1	3	a Rod
Collecting stones, supposing two tons gathered to each rod	0	8	
Two carts from the quarries	1	0	
Leading	2	0	
Cutting the drains by the plough . .	0	1	
	5	0	

The distance the sill and rattler had to be led, so increased the cost of cartage, as to make their cost equal to that of stones.

	£.	*s.*	*d.*
Cutting and filling 859 rods of 7 yards, at 1*s.* 3*d.*	53	13	9
3436 cart-loads of stones for filling, at 10*d.* a cart,	143	3	4
Carting the above, at 6*d.*	85	18	0
Filling, at 1*d.*	14	10	6
	297	5	7

Fifty acres of the field have been benefitted by this drainage. The general quality of land deciding the value at which it would be estimated to let, it was considered as worth 40 shillings an acre: from its locality, I conceive I am within bounds when I rate it as worth from 50 to 55 shillings. The expenditure of two hundred and ninety-seven pounds has added sixty pounds to the value of the field, which is obtained at five years' purchase, or a little less for interest. It is to be observed, the horse-work is valued as if it had been hired: the real cost of that part, done at such a season, is not, to a farmer, one-half. My

object was, to put the cost at the highest point, more strongly to enforce the advantage resulting from the practice, as it thus leaves nothing to object to.

This field had in the last course, 30 tons of manure: it is strong clay. First crop, potatoes; product, 26 hundred stone per acre: sown with wheat and clover; both these crops were admirable. The oats this last year are calculated to produce 60 Winchester bushels per acre: it is now preparing for green crop again, and to have 50 tons of manure per acre. Admitting the green crop to profit three pounds per acre by the drainage, which is only half what was lost at average prices this year on the Swede crop, this on the 50 acres would be one hundred and fifty pounds: calculating it to yield three Winchester bushels per acre more of wheat, at 7*s.* per bushel, this would be fifty-two pounds ten shillings and ten-pence per acre: for the clover for two years, 50*l.* more;—making a probable increase of produce, without any extra expense, of 252*l.* 10*s.* Thus, in a five years' course, the whole expense will, in all probability, be repaid, and an annual permanent increase of rent, to the amount of 60 per cent. gained.

Wet is more destructive to pasture than it is to grain and green crops; and as pasture is the most material object near to towns, draining, in such situations, is a more profitable improvement than in any other situation, and will consequently justify a greater expense.

When once dry land is well laid down to pasture, the improvement is permanent. If flooded with water, it cannot remain for any length of time in pasture, but must be again brought under tillage. On wet soils, improvement is almost labour in vain—costly at all times, but now ruinous.

Should the Society deem this undertaking as meriting their attention, it will be highly gratifying to me, who owe them many and great obligations.

The ambition of meriting the honour of their rewards, first directed my attention to agriculture; and I trust the

result has not altogether been without its advantages to the public.

I am, Sir, &c. &c.

JOHN CHRISTIAN CURWEN.

XXXVII.—*On Iron and Steel. By the* EDITOR.

[Continued from p. 140.]

ON HARDENING AND TEMPERING CAST STEEL.

VARIOUS compositions are used for this purpose, according to the nature of the articles to be hardened and tempered. For saws of the usual description, and springs in general, the following is an excellent hardening and tempering liquid; viz.

Twenty gallons of spermaceti oil;
Twenty pounds of beef-suet, rendered;
One gallon of neat's-foot oil;
One pound of pitch;
Three pounds of black resin.

These two last articles must be previously melted together, and then added to the other ingredients; when the whole must be heated in a proper iron vessel, with a close cover fitted to it, until all the moisture is entirely evaporated: and the composition will take fire, on a flaming body being presented to its surface; but which must be instantly extinguished again, by putting on the cover of the vessel.

The cast-steel articles, if *thin* or *slender*, may be quenched in this composition, in order to harden them; and then be blazed off, as the operation is termed, over a clear fire, in order to temper them. If the articles are *thick*, such as sword-blades, &c. they should be previously hardened, by quenching them in rain-water; and then be tempered, by wiping them over, on both sides, with a thin coating of the tempering liquid, applied by means of a round hard brush, and then be blazed off, in order to temper them.

ON MAKING CAST STEEL EXCEEDINGLY HARD.

By the following process, cast steel may be made exceedingly hard: and we have reason to believe that the celebrated files made by RAOULE of Paris, which will act upon or abrade most of the English files, owe their hardness to a similar operation. We know, also, that thin back-saws, or slit-saws, awls, and cock-heels, of an extraordinary degree of hardness, are so made.—The following is the hardening liquor:

Two pounds of mutton-suet, *not rendered*, but only chopped small;
Two pounds of hog's-lard;
Two ounces of white arsenic, powdered.

These, being put into an iron vessel, with a cover fitted to it, must be boiled, until a handful of *Mouse-ear**, fresh gathered, and which had been put into the mixture at first, shall become crisp, and float on the surface of the liquor;—a proof that all moisture is driven off. This operation, as well as that of quenching any article in it, in order to harden it, must be performed under the hood of a smith's forge-hearth, so as to carry off as much as possible the noxious arsenical fumes which arise; and the operator ought also to cover his mouth and nostrils, to prevent his inhaling them. In using this compound, it must be previously melted: and in order not to overheat the thin or small articles to be hardened, it is well to heat them upon a bar of iron previously made red-hot, and, when of a due temperature, to drop them into the liquor. The workshop will, in spite of these precautions, become more or less filled with dense arsenical fumes;—a proof that much of the arsenic must have been dissolved in the hardening liquor; and some of it, no doubt, enters into union with the steel quenched in it, so as to produce such an extraordinary degree of hardness therein.

The instructions already given, for selecting the *hardest*

* *Hieracium Pilosella.*—See Curtis's Flora Londinensis, 53, Fas. 3.

cast steel, of which these articles are to be made, must be particularly attended to; and the greatest care must also be taken in avoiding all excess of heat in forging and hardening them, in order to ensure the good effects of the process.

ON SETTING STEEL ARTICLES STRAIGHT WHICH HAVE WARPED IN HARDENING.

This must be done whilst the articles are as hot as their tempering heat will permit: and is effected, either by means of two strong iron forks, one fixed securely in an anvil block, and the other in a handle, in order to get out warps or twists sideways; or by smart blows with a hammer on the hollow side, the other side resting on an anvil previously strewed over with sand, to prevent the article from slipping away, to get out bends in it: or, otherwise, if the article be slender, such as a file, graver, &c. it may be done by brightening the concave side, and heating it, by pressing it, with another proper tool, upon the convex surface of a red-hot iron heater, securely held in a bench-vice, the article being held by one end in the tongs or hand-vices; when it will easily yield to the force impressed upon it when heated; and it may be seen, by the colour it has assumed on the brightened surface, when it has nearly attained its tempering heat. Slender files may be previously dipped into a mixture of olive-oil and spirits of turpentine, and may be safely heated as above, till the mixture begins to smoke. Sword-blades, and other articles in the *ground* state, may be heated to nearly a blue colour, over a cinder fire; and, whilst hot, be struck on a soft anvil, with a hammer made of tin, to avoid bruising them: and if *glazed* also, the blue colour may be removed, by a weak mixture of muriatic acid and water being wiped over them, without staining them much, the acid acting only on the oxided surface.

[*To be continued.*]

XXXVIII.—*A Case of Luxation downwards of the Os Humeri, successfully reduced. By* S. A. Dudley, M.D*.

This interesting case was very dexterously and successfully managed by Simeon A. Dudley, M. D., a young physician of great discernment, enterprise, and promise, in Winchester, in the state of Kentucky.

The resistance experienced by surgeons in their efforts to reduce luxated bones, before morbid adhesions have been formed, arises almost exclusively from the excessive and obstinate contraction of the surrounding irritated muscles. To attempt to overcome this resistance by mechanical force, is always productive of pain, and oftentimes of danger. A leading indication, then, is to procure a relaxation of the muscles in action. It is scarcely necessary to add, that the more complete this relaxation becomes, the greater will be the facility in the process of reduction.

It would be superfluous in me to enumerate the various expedients usually employed for the attainment of the indication in view. They are familiar to every one even moderately versed in the practice of surgery.

It will be permitted me, however, to observe, that whatever makes on the stomach a deep and highly deleterious impression, diminishes or destroys alike the power of contraction in the muscles, and of coagulation in the blood. In cases of sudden death from a violent blow on the scrobiculus cordis, from the intemperate use of cold water, from an excessive draught of ardent spirits, or from the swallowing or receiving by injection a large amount of certain vegetable poisons, such as laurel-water or a strong decoction of tobacco, the muscles can neither be made to contract, nor the blood to coagulate. These facts being known, the intrepid and judicious practitioner, accustomed

* From No. 2. of the Philadelphia Journal of the Medical and Physical Sciences. Communicated to the Editor of that Journal by Dr. Charles Caldwall, M.D.

to the apportioning and management of powerful remedies, and skilled in the adaptation of means to ends, will readily avail himself of them in cases of emergency. The truth of this, the case in question, of which the following is a brief narrative, illustrates and confirms.

On the first day of October, 1818, A. J., a labouring man, about thirty years of age, and of intemperate habits, experienced a luxation downwards of the os humeri. By several physicians in the neighbouring country, both singly and associated, efforts at reduction were immediately, repeatedly, and perseveringly made, but without success.

About eight weeks after the accident, Dr. Dudley's aid was solicited. High-spirited and fearless, the patient declared himself willing to submit to any suffering, and even to hazard his life for the restoration of his limb. His physician, no less intrepid, was equally ready to encounter a weighty and generous risk of his own reputation, to effect a cure; a duty which, in desperate cases, every practitioner owes alike to his patient and his profession.

All the most powerful ordinary means, such as deep and long-continued nausea, blood-letting ad deliquium animi, the warm-bath, forcible extension, &c. were first repeatedly and faithfully essayed.

These proving fruitless, a resolution was formed to have recourse to the effects of *deadly intoxication*. Comporting with habits in which the patient had too long indulged, this was not, in prospect, a disagreeable remedy.

Early in the morning, the copious potation of rum, brandy, whisky, and gin, was begun; and by ten o'clock A.M., such is the force of habit, three pints of these liquors had been swallowed, without producing the desired effect, or even any very obvious approach towards intoxication. At this period, another half-pint draught was administered, consisting of equal parts of rum and whisky, as hot as it could be endured. For a few minutes, this also was without effect. But at length, the patient's whole energy suddenly deserted him; and he fell, as if pierced by

a bullet, or stricken by a flash of lightning. His stupor and insensibility were deep and alarming, far beyond what the spectators had ever witnessed as the effect of liquor.

Not a moment was to be lost. Now, if ever, was the time for the reduction of the dislocated bone. After several efforts, in which the strength of six powerful men were employed, this was at length effected.

But new dangers now presented themselves; and new difficulties were, therefore, to be surmounted. So entire was the prostration of all the vital energies of the patient, that he was evidently hovering on the brink of dissolution: his sensibility was extinguished, his respiration scarcely perceptible, the pulse in his extremities not to be felt, and his skin was cold, clammy, and cadaverous.

Deglutition being now impracticable, and injections not deemed advisable, external applications were alone employed. So wholly inadequate were these for a time, that even *boiling water* applied to the feet and ancles, and aided by strong and continued friction, produced no effect: it did not even redden the skin.

Under every external impression that could be made, this state of things continued for ten hours, when symptoms of returning health began to appear. In twenty hours more, the patient had recovered sufficiently to ride home on horseback, a distance of ten miles; and in three weeks was well enough to resume the labours of a country life.

For the individual concerned, as well as his family, the most fortunate issue of the process is, that his habits of intemperance are completely eradicated. His love of ardent spirits is converted into an unconquerable dislike of them*.

* It is due to Dr. Physick to state, that the practice of inducing intoxication, with a view of relaxing the muscles in obstinate luxations, originated with him; and, we have no doubt, our ingenious correspondent would have had pleasure in conceding to him this praise, had he been apprised of the fact. Vide Dorsey's Elements of Surgery, vol. i. p. 204.—*American Editor.*

XXXIX.—*On the Modus Operandi of Medicines.* By N. Chapman, M.D.*

On this very intricate question, not a little difference of opinion prevails. The only point in the controversy which seems to be conceded, is, that the operation of medicines does not depend on any of the common laws of matter, but on a principle incident to vitality alone.

"Medicamentum, non agit in cadaver."

As this is so universally admitted, as even to become one of the established maxims of the Schools, it may be right, before we advance further into the discussion, to endeavour to fix our notions in relation to the nature of life. But as speculations of this sort, indulged to any extent, would be here misplaced, I shall exhibit my views of the subject in as narrow a compass as possible.

Of the various doctrines of vitality, one only appears to me to be at all well founded, and consequently deserving our attention. It presumes that every animated body, animal or vegetable, is endowed with a *primordial principle of life*, and which, resident in the ova of animals and the seed of plants, constitutes the power by which, in the first place, the various organs are moulded, developed, and perfected, and by which, afterwards, the animal economy is defended against the action of mechanical and chemical laws.

Located, perhaps, in the highest degree, among the digestive and assimilative organs, it enables them to change or destroy the qualities of the substances exposed to their operation, without sustaining in return the slightest injury or change. It would hence really appear, that, instead of matter, whether aliment, drink, or medicine, acting on the living system, as is commonly imagined, it is, on the contrary, the living system which operates on these matters. But such is the case only, when the vital energies are in a

* From No. 2. of the Philadelphia Journal of the Medical and Physical Sciences; of which Journal Dr. Chapman is the Editor.

vigorous and healthy condition. Different, indeed, is the result, where from debility, or other imperfection, the vital organs are rendered unfit to act upon substances, or of resisting the action of substances on the system. Whatever is taken into the stomach under such circumstances, preserves its properties unaltered, or undergoes the same sort of alteration, which it would do out of the body, or beyond the sphere of the vital powers. Each article in this state obeys the order of its affinities, and the changes which occur are purely chemical. Common matter, now acting by its own laws, the system being thus languid and decayed, sinks under an attack it cannot repel; and the processes of fermentation and putrefaction ensue, which, if not timely arrested, become the precursors, as well as the causes, of death and destruction.

Life, therefore, may be defined the principle, or power, by which the system preserves its own integrity unimpaired, and its several parts from decomposition, amidst the action of surrounding agents; while it acts upon things foreign to itself, assimilates them to its nature, and appropriates them to the supply of its exigencies, or to the redress of its injuries.

The theory I shall propose, of the operation of medicines, alleges, that they all act by exciting a local impression which is extended through the medium of sympathy. By many, however, it is still believed, that certain articles, at least, enter the circulation, and produce their effects in this way.

This latter hypothesis is evidently a relict of the humoral pathology. By the disciples of that sect it was held, that disease mainly consists in a depravation of the blood, "from too great tenuity or viscidity, by an excess of acid or alkaline acrimony, by morbific matter entering from without, or generated within."

As a necessary consequence of such notions, medicines were supposed to penetrate into the circulation, and by a sort of chemical action to correct the vitiated condition of

the fluids; and hence the origin of the terms, inspissants, attenuants, antacids, antalkalies, antiseptics, diluents, demulcents, &c. &c.

As they are now pretty generally exploded, to demonstrate the fallacy of these speculations by any very minute detail of facts or reasonings, cannot be required. All changes in the condition of the fluids are wrought by impressions made through the intervention of the solids. Not the slightest proof exists, so far as I know, of their undergoing any mutations, either by spontaneous action, or from the introduction of foreign matters; much less that such is the cause of disease, or the mode in which remedies operate.

To reach the circulation, medicines must pass either by the lacteals or lymphatics. Now it seems more than probable, in either case, their powers would be so neutralized by the preparatory processes of animalization, as to be deprived of all activity.

Can it indeed be credited, that any substance, after a subjection to the digestive and assimilative powers, retains in the slightest degree its original properties? Experiments, on the contrary, shew, that chyle, however diversified the materials may be out of which it is formed, whether animal or vegetable, has essentially an identity of nature; and instead of being a *crude*, as is commonly imagined, is in reality a highly *elaborated* fluid, having many, and perhaps all, the properties of blood, except its red colour. Three of the constituents of blood it at least contains.

1. There is one portion of chyle, which preserves its fluidity during life, but coagulates after death, by exposure to the air; and is probably fibrine.

2. There is a second portion, which resembles serum, in continuing fluid when exposed to the atmosphere, and in coagulating at the same degree of temperature as serum.

3. There is a third, consisting of globules, similar to those of blood; with this difference only, that they are much more minute.

The fact of the perfect and uniform constitution of chyle

seems to me, at once, to put down the hypothesis which I am combating. Yet, perhaps it may be said, it proves nothing in the case of medicines administered otherwise than by the stomach; as when applied to the surface of the body, or introduced into the bowels. To this objection the answer is obvious, and I think very satisfactory.

No one who has carefully attended to the phenomena of the absorbent system, can help admitting that every section of it is endowed with the power of *digestion* and *assimilation*, and the lymphatics quite as conspicuously as the lacteals. This capacity is given, as a provision of nature, to exclude noxious matters from the circulation.

The absorbents, in most instances, are fully adequate to this end: and when they are not, the substance penetrates to the first conglobate gland, which takes on inflammation, and arrests its further progress; these organs acting here as sentinels, guarding the exterior approaches of the body. That some of the properties of certain articles are displayed in the secretions and excretions, I am not disposed to deny. But it does not hence follow, that these substances entered the circulation in their primitive state. Directly the reverse indeed seems to be proved, as no one of them can be detected in the serum of the blood.

To me it is clear, that the process of assimilation, as performed either by the chylopoietic viscera, or by any part of the absorbent apparatus, completely decomposes all substances, and, however discrepant in their properties, reduces them to a homogeneous fluid fitted for the purpose of nutrition. But when thrown into the secretions or excretions, being removed beyond the control of the vital energies, chemical affinities are sometimes again brought into play, by which these substances are in part or wholly regenerated.

No slender support is given to this hypothesis by the well-known fact, that matters are found in such positions, which had not previously existed, in any cognisable state, in the blood; and furthermore, that certain articles can

only be detected in certain fluids, as the odour of garlic in milk, of asparagus in urine, of sulphur in the perspiration: and we may add, as another illustration of the same import, that the colouring principle of madder can be traced in no part of the solids, except the bones, and their immediate appendages, the cartilages. Did these articles pre-exist in the blood, instead of being regenerated in some such manner as I have stated, ought they not to be thrown out indiscriminately by all the emunctories?

Whether this explanation be received or not, it must at least be acknowledged, that no substance, in its active state, does reach the circulation; since it is shewn, that a small portion even of the mildest fluid, as milk or mucilage, oil or pus, cannot be injected into the blood-vessels, without occasioning the most fatal consequences.

Twenty-two years ago, in conjunction with my friend, the late Dr. George Lee, then resident in the Pennsylvania Hospital, I instituted a series of experiments, to this purport. All the articles enumerated above were tried in succession, together with some others of an acrid and stimulating nature, on dogs and cats, the animals selected on the occasion. But diversified as these substances are, we could discern no material difference in their effects; the whole seemingto act merely as extraneous matter in *errore loci*, producing, at first, great distress to the animal, as was indicated by its movements and cries, followed by difficult panting respiration, vomiting and purging, nervous tremors, convulsions, and death. Experiments, very analogous to the preceding, have recently, I understand, been made by Professor Caldwell, and with confirmatory results.

That the late inquiries of Sir Everard Home and others lead to a different conclusion, I am aware. Confiding, however, in the accuracy of our own observations, I must, in the present state of the question, still maintain, without the slightest qualification, the position I have assumed. The fact is, that though the blood be alive to impressions, and, perhaps, even more exquisitely than the solids,—it

being designed that all matters should be excluded the circulation,—they lose their specific mode of action, when introduced, and cause confused and disordered movements, like an irritant in the trachea, or in any other unnatural situation*.

Conceding, however, to the humoral pathologists all which their doctrine demands, still insuperable difficulties remain in the way of its adoption, to account for the operation of medicines. Not to dwell tediously on the subject, I shall content myself at present with little more than merely mentioning, that we are not at all informed by it, why our remedies, after mixing with the blood, should be directed to one organ in preference to another,—as mercury to the salivary glands,—or how indeed they operate at all.

By the *medication* of the blood, were it possible, as is contended for, we must in all instances do harm. The whole mass of circulating fluids is equally charged in this case with the medicinal substance; and therefore, while a salutary action is going on in the diseased organ, every sound part of the system becomes subjected to a similar impression, which could not fail to disturb the order of health, and create morbid derangements.

Be it alleged, as it sometimes has been, that the action of medicines, under such circumstances, is on the surface of the blood-vessels, the doctrine becomes utterly deserted, and we are forced to recur to sympathy, as affording the only explanation.

By a recent writer of high authority, whose opinions however on this point are not wholly without the taint of the humoral pathology, it is conceded, as an incontrovertible fact, that a large proportion of medicines do act by the "medium of nervous communication."

"This," says he, "is manifest, from the effects of these

* On the experiments of Dr. Majendie, on venous absorption, I forbear to comment; as on repetition here by Dr. Sommerville, they were not confirmed. The subject is now before the Academy of Medicine, where it will receive the fullest investigation.

substances being produced in a shorter time after they have been received into the stomach, than they could be, were they to act by being absorbed with the chyle into the circulating mass. The stimulus of wine or opium will instantly remove lassitude, and increase the vigour of the circulation, or of muscular exertion. Digitalis, given in sufficient quantity, very speedily reduces to a great degree the frequency of the pulse; or a large dose of cinchona, exhibited half an hour before the expected recurrence of the paroxysm of an intermittent, will prevent its attack*."

Exactly the same conclusion is deduced by Mr. Brodie, from his experiments in relation to nearly all the poisonous substances, vegetable as well as mineral: and the few which he represents as acting otherwise, really, from his own shewing, seem not to do so†.

The principle being thus clearly established in so large a number of instances,—which, if necessary, might be still further increased,—it appears to me that it should be admitted as an universal law, unless exceptions to it are very clearly made out and demonstrated. To multiply causes superfluously, is against one of the fundamental rules of philosophising; and is not less repugnant to the general course of nature, whose means are proverbially distinguished by great simplicity and uniformity.

As regards the mercurial preparations, an example particularly selected by the writer whom I first cited, to illustrate the occasional admission of medicines into the circulation, we have the most conclusive proof that this never happens, whatever may be the manner in which they are employed‡; and no doubt such is the case with all the articles of the Materia Medica. It is at least as clearly shewn, by experiments made by myself many years ago, and which have been since more than once repeated with

* Murray's Mat. Med.

† Philosophical Transactions of the Royal Society for 1811 and 1812.

‡ Experiments of Drs. Physick and Seybert, Medical Repository, vol. v.

greater precision, and on a more extensive scale, by Graduates of this School, that none of the preparations of iron, of copper, of lead, nor the colouring matter of indigo, of madder, or of rhubarb, can be traced even so far as the chyle*.

Being introduced into the small intestines of dogs, these several articles were observed to be rapidly taken up by the lacteals, the coloured ones losing their tints in passing through the conglobate glands; and, in every instance, so completely were their properties obliterated, as not at all to be cognisable by any chemical test in the contents of the thoracic duct.

Yet, it is not to be concealed, that some very respectable writers have affirmed, that certain matters do enter the circulation, and may be detected by chemical tests. Of the facts of this kind, not the least relied on, is one which comes recently from Mr. Brande. It is stated by this most eminent chemist, that the blood of a patient who had taken soda, long and largely, was found to contain that alkali in excess.

Granting it to be true, is not the force of the fact done away by the recollection, that soda is a constituent of blood, and, as such, may freely enter into its composition without detriment. All the experiments, however, on this subject have been made without adverting to a source of fallacy, which greatly impeaches their validity. On blood dead and separated into its parts, have the whole been made; and obviously under such circumstances, the elements of things may again re-combine, in a manner already noticed, which in the living state were broken up, and assimilated by the powers of animalization.

Could more proof be required of the operation of medicines being entirely independent of the circulation, it might be found in the well-ascertained fact, that many of them produce their full effects, though the heart and blood-ves-

* Hodge's Inaug. Dissertation, in which many of these experiments are contained.

sels be previously removed. Long ago it was shewn by Whytt, that if the heart of a frog is taken out, and a solution of opium be injected into the abdomen, the animal speedily becomes convulsed. The poison of the viper, according to Girtanner, applied to a frog prepared in the same way, will destroy it as soon as if no mutilation of the animal had taken place. Numerous experiments of a similar import, with other active substances, have been instituted, the results of which are so exactly correspondent, that to detail them would be superfluous. But, before I finally dismiss this part of my inquiry, I will only remark, that the converse has been equally proved, or that no extension of the impression of medicines happens in cases where the brain and spinal marrow have been destroyed, though the heart and vascular system be preserved uninjured*.

To be continued.

XL.—*On Reasoning in Medicine. By* JAMES MACLURG, *M.D.*†

"C'est une erreur de croire, qu'une experience aveugle et une habitude méchanique, tiennent lieu de principes surs, et de maximes fondées sur un solide raisonnement." *Discours sur la Commerce, par le Marquis* BECCARIA.

THERE is no art, unless this term can be applied to religion, which seems to require in its professors such a perfect harmony of opinion as the art of medicine: for there is none in which error is of so much consequence, or where a fluctuation of the mind between opposite sentiments is

* Murray's Mat. Medica.

† From No. 2, of the Philadelphia Journal of the Medical and Physical Sciences.—The following note is added by Dr. N. Chapman, the Editor of that work.

"To this article we wish particularly to call attention. It is written in the best manner of its venerable author, and discusses a most important subject, with all the force of dialectic precision, and the fascinations of eloquence.—The earliest of his productions, this Essay, can now scarcely be read without the mournful reflection, how much might have been done for Medicine, and the interests of elegant letters, had he been cast on a wider and more advantageous theatre, for the incitement, and display of the powers and resources of his large and finely-cultivated mind."

attended with such anxious distress. Yet medicine has its schisms; and the sages of our art, while they appear devoted to Truth, forget her peculiar caprice—that, though she loves to be pursued with ardour, she must still be addressed with indifference.

The keenest shafts of ridicule have frequently been levelled at this trait in the medical character. Our singular gravity and solemnity placed us, as it were, in opposition to the free, the gay, and the witty; and they eagerly seized a circumstance, which seemed to reduce this extraordinary figure to the common size; and to shew, under a face of great wisdom, much ignorance and uncertainty.

To this we have replied, that physic, like the other sciences founded on experience, is continually progressive, and therefore subject to perpetual change; so that, without the suggestions of vanity, we may sometimes be tempted to differ from our venerable ancestors. And it might have been subjoined, that physicians, notwithstanding some curious external differences, which would deceive, perhaps, an inexperienced Houyhnhnm, are yet no better than mere Yahoos. But it seems to be agreed, among the philosophers who have examined this species with the greatest accuracy, that *to associate* is not more a principle of human nature than *to separate:* for, though men have been allured by the prospect of advantage, or compelled by force, to unite themselves in vast bodies; yet it was always observed, that where the political bands which held them together were weak, and they could follow their natural tendency, these huge piles soon broke into a number of pieces: and in all the countries where the arts of policy had scarcely taken root, the inhabitants have been found divided into numerous tribes, inflamed against each other with a mutual animosity. In like manner, proceed these philosophers, we have seen a set of religious notions overrun half the globe: but the torrent soon split into a multitude of streams; and numerous sects arose, who persecuted each other with an unrelenting fury. It is not attraction alone which governs the material world: the laws

of repulsion have also their influence; and it looks as if they had both their analogous principles in the moral system.

But these internal factions, which range us under the banners of so many leaders, are equally opposite to a set of men who will acknowledge the authority of neither. The sticklers for different systems, however averse to each other, unite, like our domestic parties in politics, against a common enemy. It is hard to say when this quarrel began between empyrics and dogmatists, or when it will end. It seems to be as ancient as the origin of reasoning in physic, which could not be long after the beginning of observation itself; nor will it cease, most likely, until our philosophy has acquired perfection—an æra still more remote.

Every step of experience approaches towards system; since, by discovering the natural relation of things, it prepares us for establishing principles. And theory, or the application of these principles in explaining the phenomena around us, is the favourite process of the human mind. So delighted are we with it, that we cannot wait the necessary preparation; and our eagerness would fain anticipate those principles which yet remain to be discovered. A vapoury gleam of fancy is mistaken for the ray of science; and we pursue it through all the treacherous ways of hypothesis. For, though things, being related in nature, present themselves in a certain order to the view of the observer, he does not immediately discover that order which is invariable. Amidst the variety of circumstances which surround any fact, to seize that whereon it necessarily depends, requires a close attention, and commonly a varied experience. But the mind will follow, in the mean time, its propensity; and theories are produced and destroyed by successive observation.

System has so often fallen under the stroke of experience, that we have been led to imagine a natural enmity between them; which, by an easy transition, is extended to their several patrons. A theorist and an empiric are, in medicine, terms of mutual reproach; and as much the

badges of two opposite parties, as those of whig and tory used to be in politics.

Amidst the recriminations of both sides, it seems to be acknowledged, that improvement in our science has ever been the fruit of growing experience; and that a multitude of errors have been sanctified by the authority of systems. And it is imagined that we go but a little farther, when we affirm that these are useless, and even dangerous; that, far from aiding the progress of medicine, they lie in its way, or mislead its steps.

But their danger, in the present state of physic, is surely imaginary. If they inflict a wound, they bring along with them its remedy.

——Quâ cuspide vulnus
Sensit, et hâc ipsâ cuspide sensit opem.

The continual succession of systems prevents their acquiring an influence injurious to philosophic liberty. Their opposition has had the same effect in science, that the quarrels of contending Popes produced in religion:—it banished the notion of infallibility, which is so apt to be fostered by the blind veneration of a sect. Those gigantic forms of superstition and authority, that were encountered with difficulty, and even danger, by the first literary knights-errant, no longer bar the avenues to science. Every subject is discussed by a free dispute; and the repeated appeals to reason and common-sense prove that we acknowledge no authority which is not derived from them.

This notion of a dangerous influence in systematics, may suit a supine, an ignorant, and a superstitious age; but has no relation to the present, which is so remarkable for its free and active spirit of inquiry.

But shall we grant that they are useless? and is it credible that the industry of these gentlemen should be so active to no sort of purpose? A system cannot be built without materials; and these can be furnished only by observation. Empirics claim this field as their own: but it is evident that the dogmatic also must cultivate; and he will cultivate it with greater ardour, and probably with

more success. It is passion which excites the talents, as well as virtues, of the soul, to their most-admired efforts. We are astonished at his unwearied industry, whose curious eye seeks everywhere support for a favourite doctrine. And it is a certain fact, that the sphere of observation has been farther extended by dogmatics, than by the men who pretend to give it so much merit.

Yet it is not a mere acquaintance with particulars in detail, but a knowledge of their relations, and especially of that important one by which they are fitted to produce one another, that we are chiefly interested in acquiring: and this knowledge should naturally result from the full and large comparison which must precede every attempt at arrangement. Observations which had long remained solitary and neglected, are brought together, and acquire an useful importance. Some steps are made in forming principles; and the mass of confused experience begins to put on regularity and distinctness.

And though our associations should not be exactly agreeable to the order of nature, yet they have some advantage; as they assist the memory, which with difficulty retains a set of unconnected facts. Without the aid of system, the informations of experience must slide imperceptibly down the tide of oblivion; for no one could collect any number of them; and he would be still less able to deliver them to others. On this account, system is necessary in physic, as it is in natural history. In the former, indeed, it pretends to explain the animal operations, and to shew us how we may influence them; and is founded, therefore, on the relation of cause and effect. As this is no object of the senses, but an inference of our fallible reason, it is extremely apt to be mistaken. The attempts of the medical systematic will frequently miscarry; yet still it must be acknowledged, that his errors are readily detected. His course is regular, and may easily be traced.

But while he feels a warm affection for the child of his own fancy, he pursues, with severest scrutiny, the schemes of every rival theorist. He expunges what was absolutely

false; and limits what an enthusiasm, similar to his own, had extended beyond its proper bounds. A succeeding dogmatist shews him the same impartiality; and lops, with as little tenderness, the luxuriant growth of an over-heated imagination. One is ready to believe that this ardour, so well adapted to invention and new combinations, corrected by that *sang-froid* which a man possesses in examining the works of another, though a perpetual source of private dissention, must tend, at least, to the general good, and quicken the progress of science.

And accordingly we observe, that as the rise and struggle of parties denote firmness and health in our excellent political constitution, so the perpetual growth and contention of systems is a mark of vigour in the state of medical knowledge. When Europe was sunk in ignorance, and every sort of improvement languished, Galen tyrannized for ages in the schools of physic. The first dawning of the rays of science—

> —— ubi pulsam Hyemem Sol aureus egit
> Sub terras, cœlumque æstivâ luce reclusit,—

seemed to restore some activity to the torpid minds of men, and disclosed the buds of another system. But, since that period, they have been germinating continually; and their decay seems to be proportionably accelerated. Cullen acquired the greatest authority in modern times; but his own pupils have thrown it off, and introduced innovations of the utmost importance.

This prolific birth, as well as transitory existence of systems, are evidently connected with the progress of experiment and observation: they remind us of the ancient fable of Saturn and his offspring, while they appear to devour the theories to which they gave origin. Yet it is unjust to charge the surest faculties of our nature with these unnatural and short-lived productions. The information of the senses is right and true; though the opinions which we form in consequence are often erroneous. It is these opinions, the precipitate combinations of that busy organ the fancy, which experience dissipates in its course, while it unveils the more

beautiful order of nature. And if, in its progress through the series of connected being, it should ever reach the ultimate point, our system will be that of the world, and represent exactly the disposition of things which flowed originally from Almighty Will. In any other point of this progress, our arrangements must evidently be deficient; and, from a strong propensity of the mind to carry things to perfection, and to give them the appearance of a whole, we shall be continually supplying something from the imagination. This, I confess, should prevent our being wedded to a system: yet we may certainly treat it as a mistress,—embrace it with ardour at present, and discard it whenever we are disgusted with its defects, or attracted by the superior qualities of another: for, the best system is only the expression of our degree of knowledge, at the time of its production; and their continual change, while it discovers their weakness, is a mark of their growth and tendency toward perfection.

But, as these systems are the offspring of observation, so do they guide and assist its steps. They present a mixed prospect; where some parts are fully illumined by experience, while others are only faintly distinguished, or buried, perhaps, in a total obscurity. This is the chaos of science; and it is the business of the human mind, while it traces with wonder the operations of the divine, to diffuse over it the beauty of order. And though a difference of disposition, or, more frequently, of situation, will lead one to observation, and another to arrangement,—their labours, far from being opposite, are mutually necessary. The quarrel between empirics and dogmatics is unnatural. As well might the senses quarrel with the intellect, and each pretend to exercise their function separately. Every one sees that they are useful only as combined; and that their excellency consists in their aiding and correcting each other.

To exclaim against every kind of system, has been reckoned a proof of earnest zeal for observation. Yet what is it, really, but to declare, that we must rest stupid and indifferent spectators of the train of facts continually pass-

ing before us? For, in viewing them with any care, we soon perceive that some in the succession are intimately related. The attention excited pursues these through a variety of cases, proportioned to the extent of our sphere of observation: and a more than natural coldness must guard the temper, which escapes the effect of an emotion that hurries the mind into theory. A mere observer is a very uncommon creature; and we are rarely presented with facts unmixed with speculative notions. More frequent is that precipitation, which from observing the connexion of certain facts in a few instances, pronounces it to be constant and necessary. A perfect indifference about the matter may secure us from this error; but surely a fever of the mind, which tends, though irregularly, to use and improvement, is preferable to a fatal torpor, suspending its most important operations. The error will be corrected by the progress of experience; and frequently, in an inquisitive age, the having formed a false opinion will lead to the discovery of the truth; because it directs the attention, that source of all discoveries, to a particular point.

The number of absurd theories should not, therefore, inspire us with an antipathy to the term; nor must a panic-terror of them banish physicians from the sacred temple of philosophy. To be hurt with the imperfect and puerile commencements of reasoning in physic, and to relinquish the hopes of a rational theory, is to be offended at the childish prattle of infancy, and to expect nothing better from a maturer age. That Being, who formed the mind of man peculiarly capable of improvement, and though he fixed the limits of existence, and of the acquisition of knowledge in the individual, appointed no such boundaries in the species; has implanted in our breasts, together with curiosity, a fondness of system; and it is justified by the relations of things. Experience, while it discovers these relations, gives occasion to the exercise and display of that passion. If, therefore, we are determined to reject all system in medicine, let us oppose every obstacle to the natural progress

of knowledge. We may begin with rejecting those sciences, anatomy, chemistry, and every branch of physics, which delude us continually with the hopes of penetrating into the secrets of the economy. Impenetrable dulness should henceforth be as necessary an appendage to the profession, as inflexible gravity. Genius must quit, in despair, a walk so little accommodated to his exertion; and the art, considered as a mere species of traffic, must fall into the hands of the stupid and sordid part of mankind.

Let the sons of dulness and indolence,—or if there should be found a physician of extensive practice with a naturally barren and little-improved understanding, let him deny the use of theory. We believe, most sincerely, that he is ignorant of its proper use; and when he finds that all the profits of medicine can be reaped without such a troublesome instrument, he may really think it unnecessary;

Gestit enim nummum in loculos demittere, posthac securus.

Yet there are some, it is said, to whom the progress of our art is less indifferent, that have adopted the same notion. Diseases, they apprehend, like the other productions of nature, are known and distinguished by their sensible properties; and their cure is only taught by experience. What occasion then for theory, which has so often deceived us? The knowledge of diseases, and of their remedies, can only be acquired by an assiduous attention to practice; and an hospital is the only useful school of physic.

Nor shall we deny, that a certain assemblage of symptoms gives to diseases their sensible form. It is the arrangement of these forms, according to their relations and differences, which makes the business of nosologists. They adopted the method, that had appeared so successful in the distribution of animals and vegetables. But these are multiplied continually in the same form; and Nature has drawn a line between their several species, which effectually prevents their confusion.

[*To be continued.*]

XLI.—MISCELLANEOUS.

Another pretended Perpetual Motion exposed.

THE public are highly indebted to the spirited conduct of three respectable and scientific individuals, in suppressing a gross imposition upon the too-easy credulity of the British Public. The Exhibition was in Fleet-street; and the admission-money demanded was two shillings for each person. It has been described to us (for we had not faith enough in the practicability of the thing to wish to see it) as consisting of two upright axes; their upper and lower pivots turning in holes made through pieces of brass sufficiently thick to enclose any communicating powers from machinery placed either above or below the axes; and pieces of glass were fixed above and below the pivots, to intimate that no motion was conveyed to the axes through them. Upon one of the axes, two toothed wheels were fixed obliquely, which worked into a long pinion upon the other axis; and upon the upper surface of one of the toothed wheels three inclined planes were fixed, having a small waggon or carriage upon each, with weights affixed to them; and it was pretended by the exhibitor, that these carriages, by their downward tendencies, were the real causes of the motion. This, however, was all pretence, and intended to divert the attention of the observers from the real source of motion.

We have already stated, that the pivots of the upright axes passed through thick pieces of brass. And it was evident, that one or other of these pieces included two toothed wheels; the one upon the pivot which passed through it; and the other upon another axis, which derived its motion from a concealed spring-movement, placed either above or, more probably, below the pivot, in the support of the machine; which spring was wound up from time to time, as its power became exhausted. One of the gentlemen offered to give the exhibitor a thousand pounds, provided he would suffer him to enclose the machine in a locked

chest, and that it should be found to continue in motion one week afterwards. This he declined to accept; but, upon their assuring him of their conviction of their being possessed of the true cause of its motion, *twice* did he refund the money he had taken from them! They did not, however, stop here; for, after detecting the imposition themselves, they thought it their duty to prevent the public from being farther imposed upon; and therefore they prepared a placard, and paid a person for carrying it up and down Fleet-street, to caution the public against being duped by any pretended Perpetual Motion. This had the effect of dislodging the proprietor from his first place of exhibition; and it was thought to have suppressed the delusion: but not so; he soon recovered from his panic, and immediately opened it again in another situation; and, in his new placard, announced that the *real* Perpetual Motion was only to be seen there: he also gave out, that it was his intention soon to take out a patent for it; and several gentlemen actually called upon the Editor to inform him thereof. The exhibitor did not stop even there; but laid a complaint before the Lord Mayor, of the annoying conduct of the gentlemen who had detected the imposition: but his Lordship, much to his credit, and to the dismay of the quack, informed him, that they had acted very properly; that their conduct was highly praiseworthy; and that, had they not done it, he should have found it necessary to have taken the same measure.

We hope that we may now congratulate the public upon being freed from this imposture; which had, however, found many believers in the possibility of the thing: and we would seriously advise all persons, in future, to inquire into the causes which actuate these pretended self-movers; and not give themselves up to the expectation that such an invention will ever be discovered.

The Society of Arts has been so very often annoyed by the claims of persons bringing pretended self-moving machines, or Perpetual Motions, before it, that it is about to

offer a premium for the best demonstration of the utter impracticability of such a thing being ever accomplished.

The imposture of another of these Charlatans, who exhibited in the Burlington Arcade, was last year detected, and soon stopped, by the Editor of this work.

The Rhenish West-India Company.

Nuremburg, Jan. 28, 1822.

THE first ship fitted out by the Rhenish West-India Company has already sailed from Hamburg to Port-au-Prince, or St. Domingo, laden with a cargo of German manufactured goods, from several States, to the amount of 124,000 rix-dollars; of which there are linens from Prussia, Saxony, Hanover, Hesse, Bavaria, and Bohemia, to the value of 65,000 rix-dollars; woollen manufactures, 10,000 rix-dollars; cottons, 30,000; silks, 2400; iron, steel, and hardware, 8500; leather (shoes and caps), 3100; glass, 1900; stationery, 500; Eau de Cologne, 1000, &c.

The greatest hopes are founded on the exertions of this truly patriotic Company; which has taken the best and most honourable way of answering the influence of England in the German markets,—not by prohibitions and restrictions, but by fairly meeting competition, and attempting to unite the thirty-four German States into one common confederation, for the purpose of maritime commerce. Whoever first conceived the idea, deserves the thanks of his cotemporaries, and especially of his German fellow-citizens.

Hamburgh, Feb. 8.

The Rhenish West-India Company, which consists of the principal manufacturing-houses of the North of Germany, and the centre of which is at Elberfeld in Prussia, has just opened a commercial communication with St. Domingo, and particularly with that part called the Republic of Hayti. It has sent out a vessel laden with articles of German manufacture, which it proposes to exchange for colonial produce. The vessel arrived safely at Port-au-Prince.

The agent of the Company, Mr. Holzchue, has had an

audience of the President Boyer, who received him very graciously, and to whom he presented some silks, on which was the following inscription: "Homage of German Industry to Alexander Boyer, President of Hayti." This attempt may have important consequences: the population of the Blacks and Mulattoes in Hayti at present amounts to 580,000, and they are living in a state of ease and prosperity. Hitherto the refuse of the English manufactures has been sold there. The solidity and cheapness of the German articles must deprive the English of this market.

We have reason to fear that the West-India Islands have been supplied chiefly by Jew Merchants, with the most deteriorated articles of the English market:—we allude particularly to the cloths manufactured from old woollens, and the rottenness of our linens through chemical bleaching, &c. And the object of inserting the above paragraphs is, to excite a better spirit among English Manufacturers; and to induce them to redeem their sinking character, by making *durable* rather than *showy* goods, and by not prostituting their chemical knowledge to such discreditable, and eventually injurious, purposes.

Making every allowance for the national feelings with which the above German paragraphs are dictated, and for the writers' natural predilection for every thing manufactured in "*Vaterland*," it must be confessed, that, although we continue to send to Germany immense supplies of fine cotton-twist from the powerful machines of Lancashire, &c., yet that their linens (from flax of their own growth); their silks (chiefly the silk of Italy); and their Saxon broad-cloths, from the improved machines made by Cockerill and Sons at Liege or Berlin, and by other able mechanists who from time to time emigrate from this country; the Germans certainly equal the best manufactures of England.

A Fatal Explosion from Steam.

We beg to call the attention of our Readers to a fatal accident which lately happened in Lincolnshire, (as stated in several of the Public Papers,) occasioned by a woman putting about three pints of water and some lime into an earthen jug or stone-bottle in order to sweeten it, corking it up tightly, and shutting it in an iron oven placed by the fire-side: some time after, it exploded with a loud report; the oven was broken to pieces, and scattered about the room; one of the pieces fractured the skull of a little girl about two years and a quarter old, who expired the next day; and another child was dreadfully scalded by the

hot water and steam: the mother escaped unhurt. The upper part of the window was blown out by the force of the explosion; and the house-door was burst open by the entrance of the external air to supply the vacuum thereby occasioned.

We insert the above, in order to caution persons against exposing water, in *earthen* vessels *closely stopped*, to heat, so as to be converted into steam: for, to the powerful effects of that, on the bursting of the vessel, all the shocking results which followed must be attributed; and not, as might possibly be supposed, from any agency of the lime employed to clean the vessel.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since January 29, 1822.

To John Hague, of Great Pearl Street, Spitalfields, in the county of Middlesex, Engineer; for his improved method of making Metallic Pipes, Tubes, or Cylinders, by the application and arrangement of certain machinery and mechanical powers. Dated January 29, 1822.—To be specified in six months.

To Sir William Congreve, of Cecil Street, Strand, in the county of Middlesex, Baronet; for his improved methods of multiplying *Fac-Simile* Impressions to any extent. Dated January 29, 1822.—In six months.

To Peter Ewart, of Manchester, in the county palatine of Lancaster, Civil Engineer; for his new method of making Coffer-Dams. Dated January 29, 1822.—In two months.

To Robert Bill, of Newman Street, in the parish of Saint Marylebone, in the county of Middlesex, Gent.; for his improved method of Manufacturing Metallic Tubes, Cylinders, Cones, or other Forms, adapted to the construction, and for the construction of masts, yards, booms, bowsprits, or casks; or for any other purposes to which they may be applicable. Dated February 5, 1822.—In six months.

To Frederick Louis Talton, of New Bond Street, in the county of Middlesex, Watch-maker; in consequence of

discoveries by himself, and a communication made to him by a certain Foreigner residing abroad, for an Astronomical Instrument, or Watch, by which the time of the day, the progress of the celestial bodies, as well as carriages, horses, or other animals, may be correctly ascertained. Dated February 9, 1822.—In two months.

To George Holworthy Palmer, of our Royal Mint, Engineer; for his Improvements in the production of heat, by the application of well-known principles, not hitherto made use of in the construction of Furnaces, of Steam-Engines, and of Air-Furnaces in general; whereby a considerable saving in the expenditure of fuel is obtained, and the total consumption of smoke may be effected. Dated February 12, 1822.—In six months.

To John Frederick Smith, of Dunstan Hall, in the parish of Chesterfield, in the county of Derby, Esq.; for his Improvements in Dressing of Piece-Goods made from Silk or Worsted, or of both these materials. Dated February 12, 1822.—In four months.

To Sampson Davis, of Upper East Smithfield, in the county of Middlesex, Gun-Lock Maker; for his Improvement upon the Lock for Guns and other Fire-arms, which enables the same lock to be used upon the percussion principle, or with gunpowder, without changing the lock or hammer. Dated February 12, 1822.—In two months.

To Thomas Brunton, of the Commercial Road, in the county of Middlesex, Cable and Anchor Manufacturer; for his Improvement or Improvements upon the Anchor, which he conceives will be of public utility. Dated February 12, 1822.—In six months.

To Elisha Peck, of Liverpool, in the county of Lancaster, Merchant; in consequence of a communication made to him by Ralph Bulkley, a Foreigner resident in the City of New York, and a citizen of the United States of America; for an Invention of certain Machinery, to be worked by water, applicable to the moving of Mills and other Machinery of various descriptions, for the forcing or pumping of water. Dated February 22, 1822.—In six months.

THE

TECHNICAL REPOSITORY.

XLII.—*Specification of the Patent granted to* James Smethurst, *of St. Margaret's Hill, Southwark, in the County of Surrey, Lamp Manufacturer and Contractor; and* Nicholas Paul, *of Villiers Street, Strand, in the County of Middlesex, Mechanician; for certain Improvements applicable to Lamps and Reflectors. — Dated 30th Oct.* 1802. *Term expired.*—[Continued from p. 166.

WITH A QUARTO PLATE.

The drawing, No. V. Plate XV., represents a mode of adapting any of our burners, by means of our screwed conical joint, to a reservoir containing oil, placed above the lamp. A, fig. 1, represents a burner, having two flat wicks, with its air-pipe and register, glass chimney and supporter, as already described. It is fixed to the tube B, by means of the said screwed conical joint at *a*. This tube, B, slides upon the inner tube, C, which descends from the reservoir of oil D; C is prevented from falling by means of a notch, *e*, made in the metal spring, E, fixed to the said reservoir, catching the metal piece, *b*, having a hole in it, through which the said spring, E, passes. This inner tube, C, has a conical valve at *c*, such as is commonly employed; and the outer tube, B, has a metal plate, perforated with holes, fixed at *d*, which catches the shank or foot of the said conical valve, and consequently lifts the valve itself, when the tube, B, is thrust up into the position represented in the drawing, and thereby permits the oil to flow from the said reservoir D to the lamp A. A semicylindrical pipe, *f*, closed

at bottom, but open at top, is fixed to the side of the outer tube, B, and communicates with its inside by an orifice at *m*, in order to admit air, and suffer the oil to flow. The reservoir, D, has, fitted to it, a stop-cock, F, having a funnel through which the reservoir may be filled with oil, when the valve, *c*, is closed, by lowering the tube, B, and with it the burner A, into the position represented by the dotted lines; and the cock must be closed previous to the valve being opened, by the burner, A, and tube, B, being thrust up again into the former position. The reservoir, D, is supported upon the plate, G, which is attached to the metal chimney, H, the upper part of which has two metal hooks, *g*, *g*, fixed to it, whereby the whole lamp is suspended from the cross-bar, I. Two slits, *h*, *h*, one in each side of the metal chimney, H, receive the branches of the metal fork, *i*, which supports the glass chimney of the lamp when the lamp is withdrawn, and also connects the reservoir, D, with the said metal chimney.

Two hooks, K, K, fig. 2, having a hole at the lower extremity of each, to receive the jointed screwed hook of the wing-reflectors, are also fixed to the said metal chimney, when those reflectors are intended to be used with the lamp, as represented at L, fig. 1; the said reflectors being supported in the same manner as is already described in the drawing, No. I., fig. 1 and 2. Where a circular-reflector is intended to be used, it is supported by a circular rim, or ledge, round the metal chimney (shewn by dotted lines), in the manner described in the drawing, No. II., fig. 1. When the lamp is to be lighted, the burner is drawn down into the position represented by the sketch made in the dotted lines; and a second notch, E, in the spring, E, then falls into the hole in the plate *b*, and retains it in that situation. Upon pressing E towards the tube, B, it is again disengaged, and the burner may be then moved upwards or downwards, as required.

Fig. 2, in the same drawing, represents the metal chimney, H: G is the plate which supports the reservoir for oil,

and is itself supported by means of the two hooks, K, K, which, proceeding underneath the plate, G, rise again on each side the metal chimney, until they terminate in two hooks above K, K, which fit into two notches, made for them in the upper part of the metal chimney, H; by which means the said plate, G, may be removed, when a circular-reflector is to be employed; and may be reinstated, in order to receive the reservoir, D. At *h* is shewn one of the slits which receive the fork, *i*; and at *l*, *l*, are two hooks, which pass through holes made in the wing-reflectors to receive them, and on which the reflectors rest at their extremities, which are nearest to the metal chimney.

In fig. 6, D is the reservoir of oil, with its stop-cock, its descending tube, C, and its valve at *c*; and the spring E, with its two notches at *e*, *e*.

In fig. 4, A represents the burner of the lamp, with its two wicks and an air-pipe: *a* is the conical screwed joint, by which it is attached to the tube, B, which has a projecting piece *b*, having a hole in it, through which the spring, E, fig. 1 and 3, passes; and a plate perforated with holes at *d*, to lift the plug of the valve, *c*, fig. 1 and 3, and a semicylindrical pipe, *f*, closed at the bottom, but open at top, attached to it, and communicating with its inside, by an orifice at *m*, for the purpose of admitting air, and suffering the oil to rise in the said semicylindrical pipe, or cistern, *f*.

[*To be concluded in our next.*]

XLIII.—*An Account of the Cultivation of Mushrooms. By Mr.* Thomas Rogers, *Gardener to* Edward Jenkins *Esq.* F. H. S. *at Thorpe Hall, near Peterborough.**

Having met with considerable success in the cultivation of *Mushrooms*, both as regards the quantity and the quality of the produce, I am naturally led to ascribe it to the method

* From Vol. IV. Transactions of the London Horticultural Society.

I have practised. I will first speak of the preparation of the spawn, which I manage in the following manner.

I collect pure cow-dung, not fresh, but such as I happen to find in the park, the fields, or the farm-yard; with this I mix the scrapings of roads, in the proportion of one half of the latter article to one of the former, adding to it about one-third or a fourth of vegetable mould, obtained from leaves or decayed sticks. These ingredients being well worked up together, the compost is formed into bricks about nine inches long, three and a half broad, and two thick. The bricks are exposed to the air and sun, and suffered to attain such a degree of solidity, as to bear a considerable pressure, but not to dry hard. They are then removed to a shed, for the purpose of being laid up in *strata*. Three or four rows are first placed on the ground, with interstices of about one inch in width between the rows and the bricks: into these interstices or spaces, loose spawn, such as is found in the litter of old mushroom-beds, is scattered; and over the whole surface of the layer such spawny litter is likewise spread. Should there be no old mushroom-beds at hand to furnish the scatterings, some spawn-bricks must be broken to pieces in order to supply them. The first layer having been thus treated, another is put upon it, and likewise interspersed and covered with spawn and litter from old beds. A third and fourth stratum may be laid on, or more, and regulated in the same manner. The whole pile being completed according to the quantity that is required, it is covered over with hot stable dung, and litter; and in two, three, or more weeks, according to the state of the weather, the bricks are filled with spawn, and may be laid by for use. I will not hazard an opinion, whether the cow-dung itself contains the elements of spawn, or only acts the part of a *matrix* or receptacle; but this I can state, that mushroom-spawn is generated in other dung, besides horse-dung; for I once found it plentifully in pigeon's-dung. As I have used this preparation of spawn for a length of time, the essence of cow-dung must entirely preponderate in my

composition; though the origin of the spawn should at first have been derived from horse-dung. I may add, that, when managed in the manner I have described, it yields spawn as productive as any that can be obtained. I was formerly taught to believe that it was essential to mix a portion of horse-dung in the bricks; but my experience has since convinced me, that cow-dung alone answers the purpose. The spawn is generated in it plentifully, and of a good quality.

It is of importance that the bricks alluded to should not be left in a situation which would cause the spawn to work; an effect which would be produced by moisture, combined with warmth. Therefore, when the spawn is bred, the bricks must be laid in a dry place, to prevent the process of germination. The spawn must not be suffered to advance towards the rudiments of the mushroom, which consist in little threads or fibres; for in this state it ceases to be useful in spawning a bed. As soon as the rudiments are formed, they must be left undisturbed, or they perish. They will grow into a mushroom on the spot where they are developed; but when removed or torn up, they are destroyed. A piece of spawn which appears in filaments or fibres, is no longer applicable to a mushroom-bed: it may produce a mushroom in itself, but can serve no other purpose. The spawn that is to be inserted in a bed, and to receive its developement there, must not be gone so far, but should only have the appearance of indistinct white mould.

The spawn being duly prepared, the beds are next to be considered. I have generally made them in a shed, against the wall, sloping from the wall, downwards; about two feet high at the back, and perhaps a little less than one foot in front. The materials for the bed are horse-dung mixed with litter, such as is commonly used for hot-beds: dry leaves may be added; or the greater part, if not the entire bed, may consist of leaves. I do not employ the

dung fresh, but after it has lain on a dunghill, and has been frequently turned and well worked. There must be no rank heat in it, for the spawn would be killed by an excess of warmth. The temperature of the bed should be between 50° and 60°: from 52° to 55° may be quite sufficient. When the temperature is reduced to a proper state, the spawn is inserted. If the bed happen to be dry, I put a layer of moist manure, of the same quality from the dunghill, upon the spawn; or if, on the other hand, the bed be too moist, I put a layer of drier manure over it: these layers I make about two inches thick. The mode of spawning is the usual one; namely, the bricks are broken into small pieces, which are inserted at three or four inches distance from one another. The beds are earthed over about one inch and a half thick, and ultimately covered with hay of different thickness, according to the state of the season. I have never made use of fire-heat; but always succeeded in regulating the temperature of my beds by means of covering. I scarcely ever have occasion to water the beds, owing to the materials of which they are composed.

The produce from beds of this description has been ample, and the quality of the mushrooms excellent, rich, and well-flavoured: they are of great size and thickness, when suffered to grow; one, for example, weighed eighteen ounces. They yield abundance of juice, when dressed, or prepared for catsup. There is no doubt that their quality depends upon the manner in which they are nourished: if they are meagerly fed, their flavour and substance will be poor in proportion. Thence, artificial mushrooms are, generally, richer and higher flavoured than those which grow naturally: and again, among the artificial produce, those will surpass which are reared on large and deep beds.

XLIV.—*On a new Portable Boiler: containing also an Improved Blow-pipe; and Oxygenated Matches, Acid Bottle, &c. for procuring Fire and Light.* By the EDITOR.

WITH A PLATE.

THIS boiler is made of tinned sheet-iron, soldered together; and is only about four inches high, two inches broad, and one inch in thickness. It has a handle of a novel construction, fitted either to lie quite close to the side of the boiler, or to be raised up, to serve the purpose of a fixed handle. In order to explain it, we must refer to figs. 1 and 2 of Plate XVII. in which A, fig. 1, is the boiler, viewed at its back; and fig. 2 is a side view of it.—B, C, are the two moveable parts of which the handle consists: the part B is jointed to the part D, which is soldered to the boiler, and also to the part C: across the lower end of the part C is soldered a wire, E, the ends of which project on each side, as shewn at E, E, in fig. 3: these projecting ends slide up and down in two grooves F, F, made by turning over the edges of the plate G (shewn separately in fig. 4), which is soldered to the boiler; and the upper ends of these grooves are closed with solder at H, H, and thus stop the part C of the handle from rising any higher, than to suffer the other part B to stand at a right-angle with the boiler. The handle is shewn in this situation, in fig. 2; and also by dotted lines, as when pushed down, and lying close to the boiler, as shewn in fig. 1.—I, is the lid of the boiler, turning or opening upon a hinge soldered to the boiler.

Description of the improved Blow-Pipe.

This is shewn, as put together ready for use in fig. 5. J, K, are the two parts of the body of the instrument, made of thin brass tubes; which are united at L, by means of a smaller piece of tube being soldered within either of the parts J or K, and over which the other part is slipped, as shewn in the figure. Figs. 6 and 7 shew those parts separately. The part K is bent at a right-angle, and into the end of it a block of brass is soldered having a screwed

hole, into which any one of the nozzles M, M, with apertures of different sizes, can be screwed at pleasure. One of these nozzles is shewn separately in fig. 8: it has a stem or pipe, N, which projects considerably within the body, K, and prevents the escape of any condensed moisture through the nozzle, until it should have accumulated so much as to overflow that projection. This may, however, be obviated, by a provision to be hereafter described. It will be seen by the dotted lines, in figs. 7 and 8, that the hole in the pipe of the nozzle, N, is bored as large as may be, until it is suddenly tapered away to form the orifice of the nozzle; and thus, no obstruction is made to the free passage of the air to the orifice; nor is it, as is commonly termed, *wire-drawn*, a fault which occurs in many blow-pipes; and especially in those which are made conical, or gradually becoming smaller from the mouth-piece to the nozzle. But besides this, the blow-pipe has *an extra orifice*, being a small hole made at O, (see figs. 5 and 7,) which suffers a part of the air to escape that way; enough however still passing, through the other orifice, to produce all the necessary effects required in the use of the blow-pipe; whilst, by means of the two orifices, the painful necessity of holding the breath for a long time between each inspiration is entirely done away, and the lungs permitted to play freely. We hardly need dwell upon the great benefit derived from this improvement, and for which the Editor acknowledges his obligation to the scientific and ingenious Mr. Samuel Varley. This extra orifice, O, affords the opportunity of completely freeing the instrument from any condensed moisture, which, as before mentioned, might have accumulated therein; for, by merely holding the blow-pipe with that orifice downwards, and blowing through it, the moisture is instantly driven out. The upper end of the tube J is made of an oval form, to accommodate it the better to the lips of the operator; and it should either be well tinned, or, which is better, made of silver. The other nozzles may be very conveniently carried within the body

of the instrument, for the sake of portability; in which case, it may be as well also to provide a cap, as shewn at P, in fig. 9, to shut over the part L, and prevent them from falling out of the body.

On the Preparation of the Improved Oxygenated Matches.

These matches are formed of slender rods of lime-tree or fir, about the tenth or twelfth part of an inch square; and are made, if of lime-tree, by means of a circular saw; but if of fir, they may either be sawn or cleft. The length of them may be about three inches. These matches must first be slightly tipped with sulphur; the better to insure their igniting, and to defend the wood, in the manner of a varnish, from being wetted with the sulphuric acid with which they are brought into contact, and which, as is well known, is a complete extinguisher of flame. The disuse of the sulphur in this country, by an overstrained and unnecessary refinement, has very considerably lessened the estimation in which the oxygenated matches were formerly held. On the Continent, they have always been sulphured; and their use is there most extensive, as they deserve to be. Another evil also has arisen from the English oxygenated matches being formed of *mere shavings of wood;* which are much too slight to bear the requisite degree of pressure, on being suddenly thrust into the bottles, in contact with the asbestus moistened with sulphuric acid, in order to kindle the chemical preparation they are furnished with: this latter evil is remedied by the above directions for making them square, and, consequently, making them much stiffer, and better adapted for use.

Oxygenating Composition for the Matches.

Chlorate or oxymuriate of potash, eighteen parts;
Starch, three parts;
Flowers of sulphur, three parts;
Gum arabic, one part. A little vermilion, to colour it red, may be added or not, at pleasure.

The chlorate of potash must be well ground, separately, in a Wedgewood's stone-ware mortar, with a pestle of the same material; and then the other ingredients may be ground all together: and when of a sufficient degree of fineness, the chlorate of potash must be added, and the whole well mixed together, by gently rubbing them round continually with the pestle, and carefully avoiding all blows or hard pressure, lest the detonating mixture, thereby formed, should explode. A sufficient quantity of water must then be gradually added, and mixed, by rubbing, with the other ingredients, to form a composition about the thickness of cream. This composition must be thinly spread over the flat bottom of any proper vessel, and the sulphured end of the matches dipped into it, so as for each to receive a small portion: and they must then be carefully laid around the edge of a table, &c. at a small distance asunder, with their coated end hanging or projecting a little over the edge, for the purpose of drying: after which they will be fit for use. Figs. 10 and 11 represent a match shewn at full length, and in section.

Of the Acid Bottle, &c.

Some improvements have lately been made in this bottle, by the addition of a top or handle of pewter, firmly glued to the cork, whereby it is much more easily drawn out or replaced. Fig. 12 represents a square bottle, having asbestus, previously well beaten to fibres, and moistened a little with concentrated sulphuric acid, rammed hard into it; and its cork fitted up with the above-mentioned pewter top or handle; a side view of which handle given in fig. 13, and an inside view of it in fig. 14, to exhibit the projecting lines cast within it, in order to roughen it, and thereby enable the glue to secure it firmly upon the top of the cork. The cork itself is also coated with tallow, which not only defends it very considerably from being acted upon by the sulphuric acid, but also contributes to its more effectually closing the bottle, so as

to prevent the moisture of the atmosphere from weakening the acid; and it also facilitates the opening and closing of the bottle. Another advantage of using the pewter handle is, that it prevents the fingers from being wetted by the sulphuric acid—as is generally the case with the corks, as commonly used,—and the consequent destruction of the linen, &c. employed to wipe the acid from the fingers.

Having now described the construction of the boiler, the preparation of the oxygenated matches, and the fitting up of the acid bottle, it only remains to state, that a supply of the matches must be inclosed within a Morocco leather or paper case, with a top to pull off, similar to that shewn at fig. 15, to preserve them from injury: and, by the addition of a piece of wax candle, shewn at fig. 16, such as are commonly used for coach-lanterns, the apparatus is complete.

The disposition of the several articles enumerated within the boiler is shewn in figs. 17 and 18: the former being an elevation thereof, and the latter a plan. An abundance of space to hold them all is thus afforded, notwithstanding the small size of the boiler itself: and a little soft paper being interposed, will effectually secure them from injury, as it prevents their shaking about.

On the manner of Heating the Boiler.

This is shewn, on a smaller scale, in fig. 19. The flame of the wax-candle being directed upon the front of it near its bottom, by means of the blow-pipe, the temperature of the water contained in it will, in a very few minutes, be raised to a sufficient degree, for the purposes for which it is calculated.

It will be difficult to enumerate the various uses of this apparatus: some of them may, however, be mentioned. It is quite unnecessary to dwell upon the importance of the blow-pipe, to the mineralogist, the geologist, the chemist, &c. &c.; and a very considerable improvement made in

the ease and facility of using it will, no doubt, be duly appreciated by such persons.

A portable boiler must be acknowledged to be a valuable acquisition to the comforts of all persons in travelling, whether for the purposes of heating water for shaving, for beverage, &c. &c. The boiler, with its improved handle, is also capable of serving, on many occasions, as a substitute for a drinking vessel. The advantages of a facile mode of obtaining fire and light need not be insisted upon: and surely the combination of the whole, in its very convenient and portable form, will not be deemed the least of its merits.

XLV.—*On an Improved Bullet-Mould and Nipper. By Mr.* EZEKIEL BAKER.*

WITH A PLATE.

24, Whitechapel-Road, Feb. 8th, 1821.

SIR,

I TAKE leave to request you will lay before the Society for the Encouragement of Arts, &c. a new-invented Bullet-Mould, which, after infinite labour and very considerable expense, I have brought to perfection; and, in claiming the merit of the invention, I trust the following explanation of the improvement will be satisfactory to the Society:—

First, The mould has a much larger countersink on the top, and of course holds a greater quantity of melted lead; which, as it sinks in the mould, prevents that hollowness which is generally found in balls cast from moulds in the usual way, and consequently renders them far superior.

Secondly, The steel-cutter on the top of the mould is a considerable improvement on the old cutter, as will be instantly seen by cutting off the castable, or neck of a ball, with each of the cutters. My invention consists in taking off the castable quite clean at once, and at the same time preserving the globular shape of the ball: consequently,

* From Vol. XXXIX. of the Transactions of the Society of Arts, &c. &c. In a Letter to their Secretary.—The Society voted their Silver Vulcan Medal to Mr. Baker, for this invention.

the labour and time which were formerly devoted to nipping and trimming, or filing off the exuberance, are now, by this method, entirely saved, and the ball at one motion is made quite perfect. The double advantage of cutting the ball true in so expeditious a manner, and rendering the balls themselves more perfect, must be instantly perceptible, and I trust will meet the approbation of the Society; who must be aware of the essential importance of the invention to all fire-arms, but more particularly so to rifle-barrels, which require the greatest accuracy.

Thirdly, Against the cutter is placed a small cup to hold the ball, which renders the process of cutting off the neck more easy and expeditious.

Fourthly, Under the mould is placed a solid stud, for the purpose of being screwed in a vice, when opportunity offers; by which the balls will be cut easier and much faster than when simply held in the hand.

Having thus briefly described the new mould, and explained the advantages of the invention, I have to request you will submit it to the inspection of the Society; as I am most anxious to receive their approval before I offer it to public notice. I will not detain you longer by recapitulating the advantages I should individually have experienced by an earlier discovery, nor the labour and expense which would have been saved by its adoption; but shall be happy to furnish any additional information that may be required by the Society; and have the honour to subscribe myself,

Sir, &c. &c. &c.

A. Aikin, Esq.
Secretary, &c. &c.

EZEKIEL BAKER.

Reference to the Figures of Mr. BAKER's *Bullet-Mould and Nippers,* Plate XVI.

FIG. 1, the bullet-mould entire; *a a*, the nippers of a curvilinear figure; *b*, a spherical depression, formed in the head of the screw-rivet, which connects the two halves of

such as is used for common grafting, must be placed round it: then put the root in fine mould, in a pot of such a size as will bury the graft half way in the mould; place the pot on a little heat, in the front of a cucumber or melon frame, if you chance to have one in work at the time: I prefer the front, for the greater convenience of shading and watering, which are required. A striking-glass may be put over the graft, or not, as you please. In about three weeks the root should be shifted into a larger pot, if it be too soon to plant it in the border, which will probably be the case: for, supposing the work was begun in March, the plant cannot go out till the end of May; so that the shifting will be very essential, to promote its growth till the proper season of planting out shall arrive.

The specimens I have sent for exhibition will shew how perfectly the new plant is formed on, and united to, the old root: you will also observe, that the eyes from whence the shoots of next year are to proceed, are only on that part which was next the graft; whilst the old tuber remains solely to furnish nutriment to the new plants, from the roots which issue from its lower end.

I remain, Sir, with much respect,

Kensington Gore,
Aug. 20, 1821.

Your obedient Servant,
THOMAS BLAKE.

XLVII.—*On an Improved Spring Crutch, for the Pendulums of Clocks. By Mr.* CHARLES BRANDT.*

62, *Jermyn-street, St. James's,*
Feb. 8th, 1821.

SIR,

I SHALL feel obliged if you will have the goodness to lay before the Society for the Encouragement of Arts, Manufactures, and Commerce,—of which I have the honour to be a member,—a model of an adjusting crutch for clocks. It is my invention: and the simple, easy, and correct manner

* From Vol. XXXIX. of the Transactions of the Society of Arts, &c. &c. In a Letter to their Secretary.—The Society voted their Silver Vulcan Medal to Mr. Brandt for this invention.

by which you may set a clock in beat, has flattered me that it would be worth the Society's consideration. The difficulty of putting common clocks in beat, is occasioned by the necessity of bending the crutch, which can never be correctly done; whereas this is done by one simple adjusting screw.

I am, Sir, &c. &c. &c.

CHARLES BRANDT.

Reference to the Figures of Mr. BRANDT's *Adjusting Crutch,* Plate XVI.

The stem of this crutch is formed of two lengths *d d* and *g g*, figs. 6 and 7 loosely bound together, by means of a screw *h*, the insertion of which is at the lower extremity of the upper piece, and about half an inch below the upper extremity of the lower piece. This latter, therefore, may be considered as a lever, of which the screw is the fulcrum. A moderately strong spring is secured to the upper piece of the stem, so as to act, at *d*, on the short arm of the lever, and tending to throw it out of a vertical position. A milled headed adjusting screw *f* passes through the nut *e*, and thus acts on the lever in a direction opposite to the spring, enabling the artist to obtain precisely the degree of obliquity required to put the clock into true beat.

XLVIII.—*On Iron and Steel.* *By the* EDITOR.

[Continued from p. 214.]

ON HARDENING AND TEMPERING SPRINGS AT ONE OPERATION.

THIS is peculiarly applicable to springs made of steel wire, or of sheet steel; and is found to render them considerably more elastic, and less liable to crack in hardening, than by the usual processes. It is effected in the following manner:—The springs are heated to the proper degree for hardening, in a crucible placed in a proper furnace; and, instead of being quenched in oil or water, they

are plunged into a metallic bath, kept, over another furnace, at a heat a little below their tempering point, which is ascertained by means of a pyrometer immersed in the bath; and thus they are not cooled entirely, as in the ordinary methods (which renders them exceedingly liable to crack in hardening), but only to *their proper tempering degree.* The metal for the bath may be plumber's solder, or any alloy of tin and lead, which is capable of fusing at, or a little below, the proper temperature. And the pyrometer may consist of a slip of brass and one of steel riveted together, which are secured firmly at one end to a metal plate forming the basis of the instrument; and, at the other, act on the shorter end of a lever or index, turning upon a pivot or centre, and whose longer end marks the degrees of heat on a graduated arc formed upon the surface of the metal plate. The whole should be inclosed in a case, to guard it from being clogged by coming into contact with the lead and tin. The heat of the bath is lowered, from time to time, as required, by the addition of more of the metal, or by abating the heat of the furnace.

Our readers will here see a great similarity, in principle, with Mr. Perkins's ingenious method of preventing his steel blocks from warping or cracking in hardening; namely, by nearly cooling them down to their tempering heat, and not entirely cooling them, as is usual. It was, however, discovered and practised in this country several years ago, long before Mr. Perkins made known his process, by Mr. James Stone, mechanist, of Warwick Street, Golden Square, who, in consequence of the great loss sustained by hardening and tempering his springs in the usual method, was forced, from necessity, to adopt a better; and was fortunate enough to discover the above, as accidents now seldom happen in hardening and tempering his springs. It should, however, be mentioned, that he finally quenches them in oil, and blazes them off as usual, in order to secure their toughness, and to coat them with a sort of oily varnish, to guard them from rust.

ON RESTORING THE ELASTICITY OF HARDENED AND TEMPERED STEEL ARTICLES.

Saws, sword-blades, clock- and watch-springs, &c. which, after being hardened and tempered, require to be ground and polished, or otherwise brightened, lose their elasticity or springiness in those operations, so as to appear soft on bending them, although they are as hard as ever: these qualities are again restored to them, either by heating uniformly over a clear fire made of cinders, urged by bellows, or over the flame of burning alcohol, or by inclosing them in a smouldering fire made of wood-ashes and embers, to a blue colour: which colour may either remain, or be removed by the application of diluted muriatic acid, as before described in p. 214 of our last Number.

ON THE PARTIAL CONVERSION OF IRON INTO STEEL.

It is frequently highly desirable to form articles of iron which may afterwards be superficially converted into steel. In the instance of rasps for the use of sculptors, it is indeed particularly necessary; as thereby, whilst the teeth on their surfaces are as hard as usual, the rasps admit of being bent into any form of curvature suitable to the intended purposes. The Editor, through the kindness of that eminent sculptor, the late Mr. James Smith, is now possessed of a half-round rasp, made in Italy, which fully possesses the admirable qualities above alluded to; and indeed, during the late war, such rasps were become exceedingly scarce and dear. Now it is evident that such rasps need only to be made of iron, and their surfaces afterwards case-hardened in a slight degree, entirely to resemble the Italian rasps.

A similar advantage is likewise obtained in forming slender articles of pure iron; such as that afforded by decarbonating cast-steel, and afterwards case-hardening them slightly; as thereby their surfaces are fitted to receive a high polish, whilst their interior still continues soft

and tough; and therefore the articles are less liable to break in use than if they were made of steel, or case-hardened throughout.

[*To be continued.*]

XLIX.—*On an Arcograph, or Instrument for Drawing and Measuring Arcs of large Circles.* By BENJAMIN ROTCH, *Esq. of Furnival's Inn.**

SIR, *March* 21, 1821.

I HAVE to beg you will do me the favour to submit the instrument sent herewith, and which I have called an Arcograph, to the Society of Arts, hoping they will find it worth their consideration.

I am, Sir, &c. &c. &c.

BENJ. ROTCH.

This instrument resembles in use the cyclographs of Mr. Nicholson and others, being intended for the purpose of describing, on a given chord, circular arcs, the centres of which are beyond the limits of the drawing-board, &c. and which, therefore, cannot be obtained by means of the compasses. The instruments above alluded to, however, are not capable of indicating the measurement in degrees of the arcs which they describe. This very desirable improvement is effected by the addition of a graduated quadrant, the divisions of which shew, on inspection, the magnitude of the arc contained between the extremities of the chord line; that is, between the points of the blocks *g g* (Plate XVI. fig. 8.), against which the limbs of the instrument work.

a a, *a a* are the two limbs, made either of wood or metal: to one of these is attached the brass quadrant *b b*, divided

* From Vol. XXXIX. of the Transactions of the Society of Arts, &c. In a Letter to the Secretary.—The Society voted their Vulcan Silver Medal to Mr. Rotch for this invention.

into 180 parts: attached to the other limb is an arc *c d e*, rather exceeding a quadrant: at *c* a fiducial edge is formed, and a point is marked at 90 degrees from the extremity of *d*; so that, when the point *c* and zero on the graduated quadrant coincide, the two limbs *a a*, *a a* are in a straight line: on the outer edge of the quadrant are two projections, with steel screws, on which work the nuts *f f*, the shoulders of which, clamp the arc *c d e* to the quadrant *b b*, in any position. It is evident, that, when the limbs are placed at an angle of 90 degrees, the point of the intersection, when made to traverse between the blocks *g g*, would describe a semicircle; and, if placed in a straight line, the same point would only describe a straight line, or no portion of a circle: therefore the quadrant being formed into 180 divisions, the division marked by the point *c* will always indicate the quantity of the arc drawn by the instrument. The arc *c d e* is jointed near the fiducial edge, for the purpose of turning up, out of the way of the blocks, when the limbs approach towards a right angle. Fig. 9 is a section of the joint on a larger scale: the axis is a tube for receiving the pen or pencil, with a flanch at the lower extremity. On this axis turn the two portions of the joint attached respectively to the limbs of the instrument; and the whole is surmounted by a collar, on the top of which the hollow axis is riveted; and this rivet binds the whole together, by means of the flanch at the lower extremity of the axis. The blocks *g g* must not be so thick as to prevent the socket or tube which receives the drawing pen or pencil from passing over them.

L.—*On the Parolic Cement. By the* EDITOR.

THIS cement—which is termed *Parolic*, or *Universal*, from the great variety of purposes it is applicable to—is of the class of those termed *caseous*; the curd of milk forming the principal part of its composition. It was invented by the Editor, in the year 1811; and a considerabe quantity of it has been since made and sold by Mr. J. I. Hawkins, under

the above title; but the composition of it has hitherto remained a secret to the public. It will perhaps be a convincing proof of its merits, to say that it is a complete substitute for the celebrated *Vancouver's Cement*, now in such universal demand.

To prepare this cement, take the unsalted curd of skimmed milk, after pressing the whey out of it, and break it into lumps: distribute these lumps upon linen sheets laid upon the floor of an airy room, to dry; and frequently, from time to time, as the curd acquires greater consistency, stir and break them into smaller masses, either with the hands, or with the assistance of a flat board, and a bat or rubber of wood; until at length it becomes dry enough to grind in a steel coffee-mill, to a powder about as fine as the best gunpowder; when it must be finally dried over a stove, and kept dry for use.

One hundred pounds of curd from the cheese-press will only afford about thirty pounds of the dry curd.

To ninety parts of this dried curd, ten parts of caustic quick-lime, made of blue marble, finely rubbed to powder and searced, and one part of camphor, must be added, and well mixed by rubbing the whole together with a pallet-knife upon a stone slab; and the whole must be then inclosed in bottles, holding about an ounce each; and well corked immediately afterwards, in order to prevent the access of air to the composition.

In this state the cement will remain good a long time; and, when wanted for use, a little of it must be poured out upon any flat earthen plate, &c. and, by the aid of a pallet- or case-knife, be instantly mixed with a proper quantity of water, to render it of a fit consistency for the purpose to which it is to be applied.

The bottle must be again carefully closed, after taking out the quantity of cement required; as, otherwise, the lime would lose its causticity, upon which its solvent action on the caseous part of the cement entirely depends.

LI.—*An improved Mode of Propagating Trees, &c. by Laying. By* SAMUEL TAYLOR, *Esq. of Moston, near Manchester.*

THIS improvement, which was communicated to the Editor, by Mr. Taylor, many years since, consists in the application of the method, long practised in laying carnations, to the young branches of trees, shrubs, &c.; and is effected much in the same manner as that lately published by Mr. Judd* for procuring additional roots in vine-plants; namely, by making incisions or slits below the footstalk of each leaf, and extending a little above it, and by cutting off carefully the sharp spurs or ends of each tongue, so as to cause them to throw out a semicircle of fibres, instead of a few at the points only. The branch is then to be secured by hooks or pegs, placed between each incision, to the surface of the earth, if that can be conveniently accomplished, by bending down the branch; or, if that cannot be done, to the surface of the earth placed in a broad pan or pot, supported upon a proper stand; and it must be covered with earth to the depth of about an inch only, the end of the branch remaining uncovered. The branch, being thus supplied with nourishment from the parent tree, will soon shoot out *both roots and stems from each footstalk*; and, when properly struck, may be cut across between each layer, and taken up carefully, so as to disturb the fibres of the roots as little as may be, and planted out; *and thus form a new tree from each individual footstalk.* We need hardly insist on the great advantages which this method affords, over every other known, in procuring a number of trees from each stem; instead of forming each stem into a single layer only, as usual.

* In the London Horticultural Society's Transactions, and republished in No. II. of this Work, page 147.

LII.—*On an Improved Glaze for Porcelain. By Mr.* John Rose, *of Coal-port, Shropshire.**

Sir, *Coal-port, March 24th,* 1820.

Having for some time made use of a glaze for porcelain which gives me great satisfaction, and into the composition of which neither lead nor arsenic are admitted, I beg leave to submit the same to the consideration of the Society of Arts, &c.

The common glaze for porcelain and the finer kinds of earthenware contains a considerable proportion of glass of lead: this ingredient however, on account of its being mixed with a certain proportion of siliceous earth and other vitrifiable materials, unites with them into a glass, which, although easily fusible, is not in the least corroded or acted on by any articles of food. It is not, therefore, from the apprehension of any injury to the health of those who use vessels of porcelain, that the use of lead in the glaze is objectionable; but because it is extremely liable to combine with and degrade the more delicate colours, especially those given by preparations of chrome and of gold. This is particularly the case in the more expensive and elaborate products, which, on account of the multiplicity of their colours, require to be repeatedly heated or *fired.* I trust, therefore, that the Society will consider the communication of a receipt for glazing, in which the above-mentioned defects are avoided, as worthy of their favourable notice.

The principal ingredient of my glaze is felspar, of a somewhat compact texture and a pale flesh-red colour, which forms veins in a slaty rock adjoining to the town of Welsh Pool, in Montgomeryshire. This material being freed from all adhering pieces of slate and of quartz, is ground to a fine powder; and being thus prepared, I mix,

* From Vol. XXXVIII. of the Transactions of the Society of Arts &c. In a Letter to the Secretary.—The Society voted their Isis Gold Medal to Mr. Rose for his invention.

with 27 parts of felspar, 18 of borax, 4 of Lynn sand, 3 of nitre, 3 of soda, and 3 of Cornwall China clay. This mixture is to be melted to a frit; and is then to be ground to a fine powder, 3 parts of calcined borax being added previously to the grinding.

The specimens accompanying this Letter, are,

1. The felspar in its rough state.
2. Do. ground to a fine powder.
3. Some of the glaze ready prepared for dipping.
4. Specimens of porcelain glazed.
5. Do. both glazed, and afterwards painted, in order to shew the solidity and brilliancy of the colours when used on this glaze.

I am, Sir, &c. &c. &c.

A. Aikin, Esq.
Secretary, &c. &c.

JOHN ROSE.

Some of the specimens furnished by Mr. Rose were placed by the Committee in the hands of Mr. Muss, and of other artists, in order to be submitted to experiment, both with regard to the perfection of the glaze itself at high temperatures, and its re-action on the several colouring materials.

Mr. Muss's trial-pieces were proved first in a common kiln, and afterwards were subjected to the action of a much higher degree of heat than it is possible that they can ever be exposed to in the fair course of enamelling. In this extreme heat, the ground of the ware is not in the least degree softened or affected; the glaze remains firm and perfectly uniform, without any specks or spits having been produced on its surface; and the colours, even the pinks and chrome-greens, come out remarkably well upon it. Mr. Rose's glaze not being so hard as that used by the French manufacturers, incorporates more completely with the colours, and renders them perfectly firm; whereas every artist knows that colours laid on French porcelain are extremely apt to chip off, crackle, and flake, if it be necessary to make them pass the fire a second time. On the whole, therefore, Mr. Muss considers the samples

placed in his hands by the Committee, as the best, both in body and glaze, that have ever come under his observation.

Similar reports of the excellency of the glaze, in the particulars above mentioned, were made by the other artists who had made trial of it.

LIII.—*Suggestions for the Improvement of the* TECHNICAL REPOSITORY. *By a* CORRESPONDENT.

SIR,

As a very sincere well-wisher to the success of your REPOSITORY, allow me to make the following suggestions; which are the result of a very careful attention to the success or failure, partial or total, of all the similar publications which have appeared in this country in the course of more than the last forty years. At this moment I have not leisure sufficient to go much into detail, or to attend to any methodical arrangement; but I shall offer my hints just as they present themselves.

In the first place, I am glad, in common with others of your Readers, to perceive that you have contracted the portion allotted to *Patents*; as they not only, in most instances, are but of little general interest, but that department seems pre-occupied in other works. An occasional insertion of *some* will doubtless be acceptable.

The fault of many, indeed of most of the present similar Periodicals, is, that they contain articles much too abstruse for general perusal, especially those on chemical subjects. Still you Work will be very imperfect, if it exclude chemistry altogether, either practical or theoretical.

If you were to give a short and plain *Monthly Report* of the actual *progress* of science, it would be very desirable. But what is particularly wanting, and what I am persuaded will greatly increase the sale of the Work, is an extension of the *Miscellaneous* part. A large, a very large proportion of the purchasers of such works may be described as *Amateurs*: to them, and to the Public indeed in general, there are a multiplicity of Receipts and Processes which would be highly acceptable. You are, perhaps, not aware

how many thousands of intelligent persons there are, who do not know the utility of soap or black-lead to a wooden joint or screw;—the method of making, or at least understanding the fire-boxes (sulphuric acid and asbestus, and the oxygenated matches*);—the rendering woollen-cloth *water-proof*, by a solution of the acetate of lead;—or the popular, simple, and *safe* mode of assisting the villager, in the bleaching of his linen cloth, by the oxymuriate of lime†. There is a variety of receipts for different glues and cements; one in particular, for fixing labels on mineral specimens, not likely to be affected by damp‡. Aikin's Chemical Dictionary contains some very good receipts of this kind. *Simple* and *practical* modes of ascertaining the foci of the magnifiers in single microscopes; and thence deducing, by tables, the degree to which objects are magnified; would be very useful. These, and innumerable other instances of general use and interest, which will occur to yourself, might, I am sure, give a popularity to your Work, that no similar one at present possesses. To these might be added, the *rationale* of many processes in continual application in the arts and manufactures; of which the workmen are necessarily ignorant. In all cases, give the ancient as well as modern names of chemical substances: thus, sulphuric acid (oil of vitriol); and, of course, every proportion in *weight* and *measure*.

Let me add, if the *Address* of the Inventors, and *Price* at which they would furnish the articles, were added to those extracts which you make from the Transactions of the Society of Arts, it will be satisfactory to your Readers, and very beneficial to the Inventors themselves. I know of, at least, four instances where the Universal Chuck for Turning

* These are abundantly explained in the present Number.—EDITOR.

† We sincerely wish this was practicable; but we are decidedly of opinion, that the destruction of the linen, as well as of the paper made from it, must inevitably follow the use of the oxymuriate of lime. See a remark to this effect, in page 238 of our last Number.—EDITOR.

‡ The parolic cement, the preparation of which is given in our present Number, possesses the desirable quality of resisting moisture in a high degree; and is admirably calculated to answer the purpose indicated by our Correspondent.—EDITOR.

would have been ordered if the price and address had been known.

A-propos; On the subject of *Turning*, now so fashionable an amusement:—while the French abound in *plain* and *popular* works on that art, in our language we have not one of the smallest degree of merit! Moxon's old book is still the best *.

Wood-Cuts are now so accurately done, that the expense of copper-plate engravings may be greatly saved †. There is a roughness in the edge of the Lithographic method, not at all adapted to the display of machinery or other minute representations ‡.

I am, Sir, your obedient servant, &c.

We have published these extracts from the Letter of our worthy Correspondent,—notwithstanding a modest request for us not to do so, on the score of haste in writing,—because they present some valuable information, as in the case of rendering woollen-cloth water-proof by the agency of a solution of acetate of lead, a fact by no means generally known; and also because they are evidently written with a sincere view to benefit our Work. He may be assured, that we shall endeavour to follow his friendly suggestions; as far, at least, as the plan we have laid down for the arrangement of our Publication will admit.—EDITOR.

LIV.—*On Reasoning in Medicine. By* JAMES MACLURG, M.D.

[Continued from p. 234.]

WHAT are the species of diseases? A fever, a diarrhœa, a jaundice, an epilepsy, are apprehended to be all of a dis-

* It will be our aim, in future Numbers, to endeavour, in some degree at least, to supply this deficiency.—EDITOR.

† It is our intention to employ these largely.—EDITOR.

‡ This is true; yet it is very useful in the representation of such subjects as we have hitherto confined it to, and deserves to be encouraged. —Let us here remark, that the great number of Plates which we are necessarily obliged to give in a Practical Work of this description, tends very considerably to abridge any reward of profit which we might fairly expect from our labours.—EDITOR.

tinct nature; yet they sometimes concur in the formation of one disease. From the different constitution of the machine in individuals, in the conspiration of its parts, and the influence of those external powers to which it is continually exposed, its disorders appear under a great variety of forms. To determine what symptoms, in any combination, are essential, and mark the specific nature of the disease, must frequently be a difficult task. It will certainly require that symptoms be traced to their origin; that the historian should turn philosopher: and we may probably differ as much in our nosological arrangement, as in our reasoning on the phenomena of diseases.

In the mineral kingdom, the method of the botanists was found insufficient, and soon yielded to one erected on a chemical investigation: for here the limits of combination are so wide, and the consequent productions so various, that our attention was confounded, when we directed it only to their external and obvious qualities. An inquiry into their composition has furnished us with an useful distribution of them, according to essential differences.

The symptoms of diseases may be considered as a language in which Nature addresses us,—as signs, whose meaning we are to investigate. We must not be contented with merely observing them, any more than with simply remarking the phenomena of the inanimate world; but should endeavour to trace them to those laws of the economy on which they depend. The improvement of anatomy and chemistry, the dissection of morbid bodies, and experiments on living animals, have certainly carried us some way in this inquiry, and, by settling the theory of diseases, have contributed to mend or confirm our practice.

If this practice had attained perfection; if every disease was defined, and the best method of treating it exactly determined; there would, indeed, be no occasion for theory. Yet, though we could suppose that men, conducted by their mere feelings, had reached this pitch of excellence in the most difficult of human arts, we must still have com-

of sciences, is not even applicable to surgery, though it is confessedly more purely an art than physic. The celebrated Petit, of Paris, constantly declares in his lectures, that the separation of physic and surgery is unnatural; and that it would be for the advantage of both, again to unite them. Yet, as far as simple dexterity is concerned, the chirurgical art has certainly been improved by the separation; and, when this is carried farther, and surgery splits into several branches, the dexterity continues to increase. We may appeal to those fine manœuvres, for which the oculists, aurists, and dentists of the present times are so much celebrated. But it is not from the dexterity which we see displayed in artificial productions, that we are to judge of what is required in operations on the animal machine. In the former, it is art which does every thing; but in the latter, all the nicer changes are performed by nature, who completes and finishes what the medical artist rudely prepares. It is not, therefore, a mere dexterity which we require in a surgeon: we expect that he should be acquainted with the powers of the machine, and be able to tell "*quid ferat, atque faciat natura.*" And thus is art so strictly connected with medicine, as to justify the remark of Petit; and, though it may be useful to practise them separately, they should certainly be studied together.

But it must be remembered, that, when we take up the defence of system, it is merely in a general view. Nor should a vindication of the privilege of reasoning in medicine be extended to all those modes of exercising it that have frequently proceeded to the length of licentious abuse. A description of the variety of opinions which they have produced, would look like an attempt to give a history of the caprices of the human mind. Some of them were scarcely born, before they were buried in oblivion—

> Ostendunt Terris hunc tantum Fata, &c.
>
> Fate shew'd them;—but so quickly dropt the scene,
> 'Twas straight forgot that they had ever been:

while others, winged with stronger fancy, mounted above the weak view of their age; and

——— through a cloud
Drawn round about them like a radiant shrine*,

they shone, for a time, the object of universal admiration. But they were mere meteors of the night; and as soon as we were in a condition to examine them, they disappeared. Perhaps many of those theories, which at present look so firm and durable, are destined to a similar fate. One would think, that, like the bodies of the sensible world, they were continually decaying, and continually reproduced in new forms.

Nor are we surprised at this account, when we reflect, that a system is an attempt to explain the phenomena of the living body in health and in disease; and that, to make it complete, a perfect knowledge of all the powers of the economy, and of their relation to one another as well as to external agents, is absolutely necessary. But no one imagines that medical science, even in our enlightened age, has reached this point of perfection: and all are agreed, that our predecessors, the nearer we approach to the origin of experimental philosophy in Europe, were plunged in a still deeper obscurity. Much therefore, of every system, though not of every one indifferently, must be merely conjectural. But this is the region of fancy, fruitful in prejudice and error; where a variety of circumstances, even accident itself, has frequently a greater influence than reason and common sense. And, if such is the temper of mankind, that there is scarcely an absurdity which authority cannot set up and habit establish, they should treat with some indulgence the common frailty—

——— Æquum est
Peccatis veniam poscentem reddere rursus.

By attending to the animal operations, we discover facts of a very different kind: some of them have an evident analogy with the phenomena of the inanimate world, and

* Milton.

seeming to be explicable from known principles; while others appear to be totally distinct in their nature and cause. The former are considered as the effects of some of those powers, which we distinguish by the general appellations of chemical and mechanical; while the latter are said to depend on an energy peculiar to animals. And thus we arrange, in separate classes, the informations of experience concerning the animal machine; and each of them is to furnish us with principles for explaining its phenomena.

But nothing can be more different than the notion of the limits of these systems, and of their importance in the economy, in the minds of different theorists. Like the undetermined bounds of the powers of our political constitution, they vary continually with the prejudices of the individual. People are extremely apt, from contemplating the operation of certain energies in a variety of instances, to grow possessed with the idea of their consequence, and to imagine their influence where it is not evident. Physicians, from the circumstances which direct our habits of thinking, have become chemists or mechanics, and applied their favourite principles on every occasion: their systems grew up in the retirement of the closet; where men frequently indulge themselves in speculations, which they never think of applying to the busy scenes of life.

But they who delivered themselves more to observation, and the study of the animal machine, perceived something in all its affections, which distinguished them from every other natural operation. And, when they saw that analogies from the inanimate world were inadequate to the explanation of the phenomena, they began to think that they should be altogether rejected.

In vitium ducit culpæ fuga, &c.

The animal operations, they believed, must depend on the energy of that being, which resides only in animals; uninfluenced by mechanical or chemical laws, since we get our idea of it by denying it every property of matter. But

reason informs us, that it is endued with intelligence, and that self-preservation is the powerful principle of its action. They naturally, therefore, fell into the doctrine of final causes; and conceived, that the only way of explaining any fact in the history of the economy, was to shew that it was useful or necessary.

And thus have arisen those systems of physic, which, with the titles of Mechanical, Chemical, and Stahlian, have made the greatest figure in modern times. They are liable to the common objections against systems in general. They owe their premature birth to our eager desire of explaining every thing, which cannot wait until the progress of observation has ascertained all the principles that are necessary to a perfect theory. Their authors are led away by an excessive fondness of simplicity, which they consider, perhaps, as ornamental to their ideal fabric. They pretend to explain all the operations in the animal body, from the view of one set of causes; just as they trace all the various affections of the soul to one common principle.

The animal machine, though it is connected with the other parts of nature, is distinguished from them; and, while it acknowledges the influence of the common laws of matter, is governed by a principle peculiar to life. Nor do I mean, by the vital principle, the soul of the Stahlians, but that energy which discovers itself particularly in muscular contraction, and is evidently different from elasticity, or any other known power in nature. Its exertions do not depend merely on the intelligent mind; since we observe them in muscles cut out from the body, and excited to action by heat, and other irritations. But, though we perceive its action independent of intelligence, it would be difficult to imagine a mind, such as ours, unconnected with this power; —unless we could conceive a mind without ideas, or ideas without sensations; pleasure and pain without feeling, or the passions relative to these without their objects; and, finally, volition without the capacity of action. By muscular motion alone are we led to the belief of an immaterial

principle in animals. And if this was not the only, as well as sufficient ground of our belief, vegetables, nay minerals, for ought we know, might be possessed of souls full of differently-combined ideas, and subject to all the variety of passions; since without this power, and machines like muscles which it might set in motion, they could never discover themselves to our senses. Every man can perceive in his companion the strong emotions which agitate his soul; especially where the natural behaviour is not confined by the rules of politeness, or rendered perplexing by the complicated influence of several passions: yet he sees only the effects of certain changes in the muscular power, which naturally should lead him no farther than their immediate cause. But it seems, the connexion of these changes with certain states of the mind is so constant and necessary, that we pass from the signs of the former directly to the latter.

On this is founded the science of physiognomy, whose first rudiments may be discovered in the unexperienced infant. Nature teaches herself these relations, the knowledge of which is necessary to our existence; and this, among the others, so essential to a social being, who in his original state had no arbitrary language. But the science can be greatly improved by observation; if we may believe what is told us of the people who have employed themselves particularly in this sort of investigation. The method adopted by one of the most eminent physiognomists in history deserves our attention. It is said, that when he wished to discover any one's inclinations, he used to fashion every gesture of his body into a perfect resemblance with him; and then, from the change produced in his own mind, he collected the situation of the person's whom he imitated: thus, while by an effort of the will he produced a certain condition of that power which is the source of muscular motion, he produced at the same time the particular frame of mind connected with it. And may we not, in this way, explain the contagion of passions so remarkable in many species of sensible creatures? Every one knows how apt

we are to catch the gestures of others; and has seen the gaping of a single person spread itself through a whole company. The propagation of convulsive disorders, among people of delicate and mobile habits, is a noted fact of the same kind: and they make it probable, that the motions which accompany the passions are communicated to the beholder, and, becoming certain conditions of the source of muscular action, produce, as in the former instance, the states of mind with which they are connected.

The material principle of motion in animals appears to be the same with that of feeling. The voluntary contraction of any muscle in the body is rendered impossible, by dividing the nerves with which it communicates: and every sensation, we know, may be prevented, either by hindering the impression upon our nerves, or by stopping the communication of its effect through them to the brain. All our sensations are, without doubt, so many different states of the mind; but they are the necessary consequences of certain determinate changes in the power we have been considering.

And the faculty of retaining ideas, of comparing, and variously combining them, seems to bear the same relation to the conditions of the common origin of the nerves: it has been weakened, altered, or entirely destroyed, by topical and evident affections of this organ. But, when the memory, the imagination, and the judgment, undergo such remarkable changes from diseases, and from material causes operating upon the body, must we not believe that these qualities of mind, like the others we have mentioned, depend upon certain states of the nervous power, and vary with them? It seems probable, therefore, that every modification of the soul, as far as it relates to the corporeal world, or can become the object of the physician's attention, will be found in some condition of that energy which belongs to the nervous fibre of animals.

They pretend, indeed, that there is no possibility of conceiving either the beginning or the continuance of motion

in our machine, except from the action of an immaterial principle? yet it is certain that the animal motions would never have begun, and would cease immediately, unless they were supported by the influence of external physical causes. In the impregnated egg is an activity ever discovered, without the application of heat? The soul had slept for ever, and the machine continued motionless, but for the action of this energy. We believe, with the greatest reason, that the brain is the seat of the intelligent principle. But in those fœtuses which are nourished, and arrive at their full growth, without any brain, what shall we suppose to have been the source of motion and activity?

We certainly discover marks of intelligence in every work of Nature; and of these, the animal machine appears to be the most perfect and exquisite. Their supreme Author has directed, by fixed laws, to the wisest purposes, the operation of brute and insensible matter. To neglect the investigation of his laws, and refer these purposes to some inferior intelligence, resembles the superstition of those idolaters, who adore in the sun the source of all the beneficent changes in nature. Such notions are the offspring of ignorance, which leads us to derive from a Being of a superior kind what we cannot explain from the view of any material energy. And they tend to make that ignorance perpetual, by setting bounds to the progress of the mind in its inquiry after physical causes.

It is in the contemplation of Nature, struggling with the powers which have a tendency to destroy life, that the Animists chiefly triumph. But the efforts of the economy to re-establish its order when disturbed, seem to depend rather on the constitution of the machine, than on any endeavours of the intelligent principle: for they do not vary with the condition of the intelligent principle in different animals, but with the state of the machine. And we certainly observe, that the *vires medicatrices naturæ* are much more perfect in a *polypus* (whose share of intelligence we may believe is not very considerable) than they are in a man: since, while they

ture with some difficulty a small wound in the latter, they form, from each of the divided pieces of the other, a complete animal.

It was easily perceived, that every analogy from the sensible world must be insufficient to explain the phenomena of life: and so far there could be no mistake, for the thing rested on simple observation. But they drew too hastily their conclusion, that the phenomena must certainly depend on an immaterial cause. For as yet, physicians had given very little attention to that peculiar energy which resides in the nerves of animals; and though a material agent does not, as far as our observation goes, resemble any other in nature. Was it then surprising, that, in their attempts to explain operations, which, however subjected to the common laws of matter, must still be influenced by this vital power, they were so often contradicted by experience? They resembled the speculative mechanic, who, having constructed a machine, with a view only to certain principles, is disappointed, on trial, by the influence of some power which had never entered into his calculation.

One is ready to imagine, from what we know of digestion, that this process can be explained by the facts which relate to mixture and to fermentation. Yet an excellent anatomist,* who has inquired, by experiment, into the state of this function in living animals, declares that it is not analogous to any chemical operation; and, to mark its peculiar nature, he has given it the name of Animalization. But digestion seems to be, in this sense, a chemical, and a fermentative process; as it changes the qualities of certain animal and vegetable substances in a determinate way, reducing them constantly to a matter of the same kind. We cannot explain its distinct and specific nature, because we are not acquainted with all the powers which concur in the operation. We calculate pretty well the effect of the animal heat, the air, the motion; and, since the ingenious

* Mr. John Hunter.

experiments of Sir John Pringle, of the saliva mixed with our food. The influence of other fluids, which may be present in the stomach, is more obscure; and we know still less of the effect of the vital power. We perceive, indeed, that nothing favours digestion more than a cheerful serenity of mind; while an afflicting piece of news at once disturbs it, and seems to change the state of fermentation in the contents of the stomach: and we know that passions of the mind can only affect this function through the nervous influence. The above-mentioned ingenious observer discovered that the process of animalization was more perfect, and sooner completed, in a vigorous animal, than in one that was weakened,—in a hungry animal, than in one which shewed no appetite. But vigour and hunger can only be referred to certain states of that power, which is the source of motion, and of sensation. It has, therefore, naturally, we may suppose, a considerable share in this operation. And, as we cannot pretend to imitate its action out of the body, we must not expect to find a perfect analogy with digestion in any artificial process.

But if those animal operations, which discover the greatest affinity with what is observed in the other parts of Nature, are still very different, and seem to owe their distinctness to the nervous influence; is it not surprising that the consideration of this power should have been so long neglected by systematics? The simplest observation must have informed them, that sensation, and spontaneous motion, distinguish animals from every other kind of being. Was it not therefore reasonable to believe, that, in explaining the animal operations, the facts which relate to sensation and motion must be of principal importance? But they were less occupied with examining and comparing the animal phenomena, than with attempts to illustrate them by known and obvious facts. Mechanics, and chemistry, supplied a large field for analogies. Some of their principles were ascertained; and to men possessed with the idea of the efficacy of these powers, and of these alone,

their application in the theory of the animal functions appeared to be easy, and natural. For the same reason that the first theory of chemistry was taken from the mechanical properties of bodies, the first theories in physic sprung from our knowledge of the other parts of nature; and were either mechanical or chemical. But the laws of the nervous power could only be determined by attending closely to the phenomena of life, and to that relation between them which might allow their being associated under general heads. The labours of the illustrious Haller were the basis of this work; which has since been enriched by other observers. And in the hands of a professor, eminent for his genius, and his extensive knowledge of the animal economy, it has grown into a system, whose principles are as true as any in chemistry or mechanics; being founded, like them, on the sure ground of observation; and are of far more extensive application in the theory of physic.

We have seen the connexion of medicine with the other sciences, and how naturally its improvement follows their progress. We acknowledge ourselves indebted to philosophy for many rational views of the economy, as well as for all our knowledge of external agents, the means of life, and fruitful source of diseases:—Theory was nursed by it, and grew up under its wings. Mankind seem to have an instinctive notion of the relation subsisting between every part of Nature; so that the view of one of her operations always suggests some opinion concerning another. This movement of the soul will often precipitate us into error; but it is constant and necessary:—

> What can we reason, but from what we know?

When it was believed that fire and water were Nature's principal agents, and concerned in her various productions, it was easily imagined that they exerted an equal influence in the animal economy: and on this ground was adopted the notion of hot, cold, moist, and dry temperaments, and of their several combinations. But, like every

other hypothesis, it must be supported by an appearance of observation. The phenomena which occurred to the most superficial view,—as, the evacuation of different fluids in different states of the constitution; and the various appearance of the countenance, that seemed to indicate a variety in the proportion of the animal fluids,—supplied this basis. And thus the terms, sanguine, phlegmatic, choleric, and melancholic, which carried a more particular reference to the conditions of the economy, were associated with the former. The terms of the ancients have descended to us, so sanctified by long usage, that we continue to employ them; though, in general, they convey certain collections of ideas very different from those to which they were originally annexed.

When chemistry began to make some progress, and had not yet acquired just principles of its own, its adepts believed, through ignorance and enthusiasm, that they could discover in it the principles of every other science. And as these rude philosophers, from the relation of chemistry to the materia medica, were particularly connected with medicine, they presently introduced into its theories the most striking phenomena of their art. Every appearance in the economy was traced to some ebullition or effervescence—some effect of an acid, an alkali, nitre, or sulphur.

Mechanical notions are so extremely obvious, their objects so familiar to the senses, and concerned in our usual occupations, that we naturally recur to them first for the explanation of any phenomenon. They very soon, therefore, obtained a place in medical theories: but they made no extraordinary figure there, until the laws of motion in solids and fluids were better ascertained, and the road of the circulation discovered: then, indeed, this system, with a band of mathematicians proceeding in all the form of demonstration, grew exceedingly formidable.

Our attention to electricity particularly, and its considerable improvement in the present age, have they not contributed towards turning our thoughts to the nervous

system? For though it is by no means demonstrated, that the nervous power is the same with that which occasions the phenomena of electricity; and the laws of this power are as independent on any such hypothesis, as the laws of gravitation are upon the hypothesis of an ethereal fluid; yet the contemplation of such active and subtile energies has enlarged our views, and drawn the attention from those principles of mechanics and chemistry, to which it was before too slavishly attached.

Thus medical systems put on different appearances, according to the different lights which they receive from philosophy. But these reflected rays, too weak of themselves to dispel the darkness, could only produce indistinct, and frequently monstrous, images. It was not till the sun arose in our own hemisphere,—and that spirit of observation which has distinguished the latter ages of Europe, began to exercise itself on the animal machine,—that we acquired clear and accurate notions. The ignorant simplicity of the ancients, the mad whimsies of the chemists, and the more solemn fooleries of the mathematicians, disappeared by degrees; and were forced to quit, though reluctantly, their hold on the minds of men. We learned to fix the bounds of those analogies, which we drew from the other parts of nature: nor was our progress stopped, when the light of analogy failed, and there seemed to be an end of all connexion of the animal system with the rest of the world. Observation still conducted us, in our attempts to collect the laws of the economy from a full induction of facts.

This sort of knowledge is so valuable, that every endeavour to extend it is meritorious: it will shew a laudable inclination, and some degree of judgment in the choice of our road, though the state of our abilities, or opportunities, may deny us the praise of a considerable progress. And even when we fail of producing a clear conviction, it is rare that, in the collision of facts, no sparks are struck out, to shew a future adventurer his way.

LV.—*A Method of making Hard Black-Lead Drawing Pencils for Artists, &c. By* Mr. Cornelius Varley.

These pencils are made of the fine Cumberland black-lead in powder, and shell-lac, melted together by a gentle heat. The compound thus formed is to be repeatedly ground to powder, either by means of a cylindrical file turned swiftly round (such as is used by pin-makers), or by a pestle and mortar; and re-melted, until it has acquired a perfectly uniform consistence; when the mass must be sawn into slips, and glued into cedar mountings, as usual in making black-lead pencils.

These pencils may be made a little harder or softer, by varying the proportions of the materials; although they are not well calculated for very soft ones. The native black-lead, however, is fully sufficient for the latter.

The great advantages of this composition consist in the strength and uniformity of the pencils made therefrom; and in the facility with which the fragments and dust from it may be re-united, to form a fresh mass, as perfect as before.

This composition was invented by Mr. Varley, about the year 1814: but it is now employed by Mr. Banks, of Keswick, to form his hardest pencils, which are excellent; who, however, had received no communication from Mr. Varley on the subject.

LVI.—*On an Economical Mode of manufacturing Oil-Gas. By* Daniel Wilson, *Esq.*

This is effected by inclosing the seeds of oleaginous vegetables in iron retorts, and heating them much in the manner employed to produce gas from pit-coal. This is indeed a most important discovery: and in those countries where these vegetables are cultivated in order to extract the oil for the purposes of combustion in lamps, such as France, Holland, &c., the saving in point of expense must be prodigious; as all the labour of crushing and pressing

the seeds, in order to extract the oil, is thus avoided: and, in fact, the carbon afforded by the combustion of the seeds is highly essential to the production of the gas; and it may also be subsequently employed as a valuable substitute for lamp-black.

We are glad to learn that Mr. Wilson (in conjunction with Mr. Aaron Manby, of the Horsely's Company's Iron-Works, near Tipton in Staffordshire) has already contracted to light one of the principal districts of Paris, including the Tuilleries, the Palais Royale, and one of the chief streets for trade in that metropolis; and also, that he is about to light the city of Lyons with oil-gas thus produced.

LVII.—*On an Improved Rail-way, and Carriages. By* H. R. PALMER, *Esq.*

WE have been much gratified in being favoured with a sight of these truly novel inventions, by the kindness of Mr. Palmer, the Inventor and Patentee. The rail-way consists of a single rail only,—not of two, as usual; and the carriage has only two wheels, the one placed before the other, instead of the usual number of four wheels. The load is divided, and placed in two receptacles, one on each side of the rail; and so much below the points of suspension, that, although the weights may be very unequally divided, yet a very considerable difference indeed would be requisite to disturb the equilibrium. Mr. Palmer proposes much advantage from the use of this novel invention, and particularly in carrying the rail-way on a level (or not, as may be required) across valleys;—the horse, whilst tracking the carriage along the rail by means of a rope or line affixed to it in the manner of a barge on a canal, passing down and up the descent and ascent along a common road or path. The saving, in point of original expense in forming such a road, is expected by Mr. Palmer to be very considerably less than in one made, on the ordinary construction, with two rails; and the cost of keeping it in

repair, he believes, will be very trifling indeed. It is certainly a bold innovation on the ordinary practice of making rail-ways; and we sincerely wish the inventor that success which his ingenuity so fairly entitles him to derive from his invention.

LVIII.—*On the Modus Operandi of Medicines.* By N. CHAPMAN, M.D.—[Continued from p. 140.]

IT results, on the whole, from what I have said, that we are to reject the fluids altogether, in our inquiries relative to the operations of medicines; because, in addition to the reasons already stated for doing so, we have, in that law of the animal economy termed sympathy, or consent of parts, a solution of the problem; which comports infinitely better with the existing state of our knowledge.

Conformably to the theory I have adopted, whenever a medicinal substance is applied to a susceptible portion of the body externally or internally, an action is excited; which is extended, more or less, according to the diffusibility of the properties of the substance, or the degree of sympathetic connexion which the part may maintain with the body generally. Thus, a set of actions is raised, every one of which is precisely similar, provided they are confined to the same system; by which is to be understood parts of an identity of structure. If, however, the chain runs into other systems, it loses its homogeneous character; the actions being modified by the peculiar organization of the parts in which they may take place. These are principles of universal application. In every case, whether it respects the operation of remedies or the production of disease, the spot primarily acted upon is a point from which is diffused the radiated impressions. This is a mode of action peculiar to living matter, and is remarkably distinguished from all the other processes. An impression is made and extended without mixture or combination, or in any degree disturbing the order and constitution of the part in which it takes place. But in chemical

operations, to which we must look for an explanation, in the event of rejecting the above rationale, decomposition inevitably occurs—and, as the result, new compounds must be formed from a union of the elements of the part with the substance applied, wholly subversive of the existing structure. By a course of medicine, and, indeed, by every meal, our nature would become essentially changed. Exceedingly preposterous as it may seem, such is the direct and legitimate corollary, from any other than the sympathetic view of the modus operandi of agents on the animated frame.

Let it not however be supposed, that I am among those who consider the blood as a dead fluid, without any immediate dependencies or connexion with the rest of the system. Every argument, on the contrary, which can be adduced in favour of the animation of any section of the solids, strikes me as being equally applicable to the circulating fluids.

Referring to the writings of Mr. Hunter for a full developement of the evidence to this effect, I shall now only state, that such a property in blood is essentially necessary to the preservation of life. Between *living* and *dead* matter there is an eternal hostility, which, under all circumstances, proves repugnant, and utterly irreconcileable. The moment a part dies, an effort is made by the conservative powers of the constitution to throw it off, as we see in the processes of sloughing and exfoliation: where it is not successful, morbid irritations commence; in illustration of which we have many well-known facts, and particularly the case of hectic fever. Even the secreted fluids cannot remain long in their proper receptacles without doing mischief; as is perceived in retention of urine, though the bladder be not painfully distended; as well as in other similar cases.

The same effects precisely would take place, were the blood destitute of vitality: instead of the source of all action and life, it must become a morbid irritant, productive of inflammation, or, what is more probable, of immediate death. These views derive no inconsiderable support from what happens in the transfusion of blood. Experiments

way, says Newton, "what I call *attraction* may be performed by *impulse*, or by some other means unknown to me. I use the word here to signify only, in general, any force by which bodies tend towards one another, whatever be the *cause*."

Of the manner in which impressions are extended, as well as of the cause of the more intimate consent of parts, we are not perhaps accurately informed. It would seem, however, that in neither case is it to be exclusively referred to the nerves, as is commonly supposed. Those sympathies which prevail among the various viscera of the abdomen, and between them and the head, neck, and contents of the thorax, may be explained, with sufficient probability, by the extensive anastomoses of the intercostals with almost all the nerves which proceed from the spinal marrow. But there are many other sympathies, not less conspicuous, between parts, the nerves of which have not the slightest connexion. It appears, that either by the co-operation of different organs in the performance of a function—as in the complex apparatus subservient to respiration; or from similarity of structure—parts, though detached, being prone to be affected by the same cause, as the parotid gland and testes in the male, and the same gland with the mammæ in the female; the habit of acting in unison is acquired, and sometimes confirmed. This habit of concerted action is termed association; and has been adopted as a principle, by Locke, by Hartley, and by Darwin, to account for the connexion in many of the motions of the body, as well as in the operations of the mind. Both the sound and morbid states of the system present numerous instances of these associated actions; some of which are constant and uniform, while others are occasional and anomalous, produced, as it were, accidentally.

The principle of sympathy pervades the body, every portion of it being susceptible of associative actions; by which means the several parts are linked together, so as to constitute one whole, or a unity of system. It is to this principle,

whatever it may be, which, uniting all the organs of the animal economy, we are to impute the wonderful concurrence and perfect harmony which is observable in its complicated actions during health. But though this general medium exists, to the reception and propagation of impressions, there are three surfaces on which remedies, and perhaps the causes of disease, more particularly operate. These are,

1. The alimentary canal,
2. The skin,
3. The organ of smell.

Each of these parts has a considerable susceptibility, and maintains a very extensive connexion with the system generally; though the stomach is possessed of infinitely the quickest sensibility to action, and the most intimate and multiplied relations. No viscus or organ, not even the brain itself, can be compared to it in this respect, or which occupies so important a station in the animal economy.

Destitute of a stomach, no animal can exist. Life may be sustained, even in the perfect animals, independently of almost every other organ. Examples are numerous of fetuses being born of a full size without a brain, spinal marrow, heart, lungs, liver, or uterus. No instance, however, has been met with, in the course of my very extensive researches on this subject, where the stomach was wanting. As the most indispensable of the vital organs, it seems, indeed, to be an inseparable incident to every variety and gradation of animal existence: no matter how inferior the being may be, it is always provided with some apparatus equivalent to a stomach.

Conveniently situated for the purpose, the stomach is probably the throne of the vital principle: from which would seem to emanate an influence, that, diffused over the system, preserves, as I have already mentioned, the order of the parts, and sustains the vigour, tone, and well-being of the whole animal economy:—

"Languido ventriculo, omnia languent."

Assailed, however, by impressions which it cannot resist, this organ, as the centre of association, becomes the seat of the first link in the chain of most diseases, and is always the chief medium of the operation of our remedies in the correction of morbid derangements.

As a continuation, pretty much of the same structure as the stomach, the intestines afford also a medium by which medicines may be introduced, and sometimes with great advantage. There is, indeed, scarcely one article of the materia medica which cannot be so managed as to produce its full effect when thus employed. To attain this, however, the dose should be largely increased, and, as a general rule, about three times the quantity is demanded. It is, perhaps, not sufficiently known, that after the stomach, by long use, has lost, or had greatly impaired, its susceptibility to the action of a medicine, this will operate with fresh and unabated force if applied to the rectum.

That the surface of the body is another part on which our remedies act, has been known from the earliest times; and the practice founded upon it is probably to be ranked among the first attempts that were made, in the infancy of our science, toward the removal of disease. The whole of the cutaneous surface seems endowed with some sensibility to impression; though the soles of the feet are possessed of it in the largest degree, and hence have been considered, by a distinguished teacher of physic, as constituting among the widest avenues to the invasion of disease, or for the introduction of remedial impressions. But, though the practice has been so long and generally pursued, it was never doubted, till lately, that, when thus applied, medicines operate in any other way than by entering the circulation. Even the rubefacient and vesicating applications were, at one time, not excepted; the effects of these being ascribed altogether to the absorption of the acrid particles of the substance, used for these purposes, into the blood, and thereby raising the excitement of the system.

Nearly about the same period, Mons. Seguin, in France,

and Dr. Rousseau, of this city, called in question the existence of cuticular absorption. But the praise of laborious and successful investigation is due exclusively to the latter experimentalist.

As early as the year 1800, it was proved, or at least rendered highly probable by him, that the *pulmonary organs*, and not the *skin*, constitute the inlet through which certain substances enter the system.

By cutting off all communication with the lungs,—which he easily effected by breathing through a tube protruded into the external atmosphere,—he found, that though the surface of the body were bathed with the juice of garlic or the spirit of turpentine, none of the qualities of these fluids could be detected, either in the urine or the serum of the blood.

Conducted nearly on the same principle, but with a greater diversity of substances, experiments, exceedingly well devised and neatly executed, have since been made by persons of opposite prepossessions, to an almost incredible extent. Contradictory as many of these are, a candid examination of the whole will still lead to a pretty satisfactory conviction, that absorption from the surface of the human body does not exist as a natural and ordinary function.

Borne down with the weight of evidence against them, most of the advocates of the ancient hypothesis were indeed prepared to abandon it as no longer tenable, when, about four or five years ago, an experiment, made by Dr. Mussey, again revived their faith in cuticular absorption. He very clearly proved, that if the body be immersed in a decoction of madder, the colouring matter of this substance will be taken in, and may be displayed in the urine by using any one of the alkalies, as a test.

Determined, if possible, to put this agitated question to rest, Dr. Rousseau, assisted by his friend Dr. Samuel B. Smith, has subsequently performed a series of experiments, —many of which I witnessed, and can therefore bear testimony to their accuracy,—with every variety of substances,

mild and acrid, volatile and fixed, nutritive, medicinal, and poisonous.

The result of these extensive researches is:—

1. That of all the substances employed, madder and rhubarb are those only which affect the urine: the latter of the two the more readily enters the system. Neither of these articles can be traced in any other of the secretions or excretions, or in the serum of the blood.
2. That the power of absorption is limited to a very small portion of the surface of the body. The only parts, indeed, which seem to possess it, are the spaces between the middle of the thigh and hip, and between the middle of the arm and shoulder.

Topical bathing with a decoction of rhubarb or madder, and poultices of these substances applied to the back, or abdomen, or sides, or shoulders, produced no change in the urine; and equally ineffectual was immersion of the feet and hands in a bath of the same materials, which, after being kept in it for several hours, afforded not the slightest proof of absorption.

As I have described, such is the state in which this interesting subject is at present left. Though, perhaps, not absolutely decided, enough surely has been done to demonstrate, that cuticular absorption rarely happens, and that, whenever it does, it cannot be deemed the effort of a natural function.

Covered as is the whole surface of the body by the impervious cuticle, it is manifest to me that absorption can alone take place in one of two ways;—either by forcing the substance under the scales of the epidermis, as in the instance of the application of frictions; or, by continued bathings or fomentations, the cuticle becomes so changed in its organization, as to admit of transudation, or the insinuation of the fluid under its squamous structure, so as to come in contact with the mouths of the lymphatics situated within.

At all events, whatever difference of opinion may be

entertained as to the degree of conclusiveness of the experiments to which I have alluded, it cannot be necessary to resort to cuticular absorption to explain the effects of substances applied to the surface of the body. We shall do this much more satisfactorily, by referring it to sympathy, and to another source which I am presently to point out.

That the skin has a very intimate connexion with the body generally, and more especially with the stomach, is a fact so notorious, that it would be a waste of time to attempt to prove it. It is through this medium that most substances applied to the surface certainly operate.

The discovery of the pulmonary absorption would seem, I confess, on the first view, to militate in some degree against this opinion, and to render it more than probable, that volatile matters, at least, are inhaled and act through the lungs. Experiments, however, have recently been made *, which go far to invalidate this supposition; and shew that, under such circumstances, it is the olfactory nerves which are the seat of the impression, and the medium through which these volatile matters produce their effects. These experiments would occupy too much space to be separately detailed. Collectively, they warrant the conclusion, that, by simply closing the nostrils, either by compression by the fingers, or by filling them up with putty, the fumes of ardent spirits, of a strong decoction of tobacco, or an infusion of opium, may be inhaled for one hour, without any unpleasant effects; whereas, if the precaution mentioned be omitted, the consequences are proved to be most distressing.

New as these results are, and inconsistent with our preexistent notions as they may be, they are rendered highly probable, independently of the respectability of the source whence they proceed, by some facts of a very striking and indisputable nature. Every practitioner has witnessed how powerfully all the volatile and odorous matters operate on

* By Dr. Rousseau.

the olfactory nerves in health and in sickness: and it is hardly less known, that, when the sense of smell is impaired by a coryza, or entirely suspended by obstructing the nostrils, the sensible qualities of most substances are so lost that they cannot be accurately discriminated; and this extends even to those articles of our food or drink with which we are most familiar. The preceding facts are sufficient, at least, to awaken curiosity on this subject; and to urge to more exact inquiries, by which the truth may be elicited and confirmed.

[*To be continued.*]

LIX.—*Observations on the Use of Prussic Acid in Phthisis Pulmonalis. Read before the Academy of Medicine of Philadelphia. By* JOSEPH G. NANCREDE, M. D.*

THE diversity of opinions, which has lately arisen, in relation to the effects of the hydro-cyanic or prussic acid, in the treatment of phthisis pulmonalis, while its very powerful action on the human system is admitted on all sides, seems to point out this new article of the materia medica as an interesting subject of medical investigation. Whether we consider the inquiry as having reference solely to the new remedy, which has excited so much attention; or whether we view it as drawing anew our observations towards a disease, the inefficient treatment of which has ever been the disgrace of our science; every one of us will agree that no subject can be more deserving our study and reflections. If, on the one hand, the total failure of the many attempts to discover a cure for phthisis be calculated to destroy our ardour in what may, by some, be considered a hopeless pursuit; on the other, a short insight into the baneful ravages of this fatal disease is well calculated to arouse our attention, and urge us on to new efforts. Where is the physician, who can look at our bills of mortality, and see

* From Vol. II. of the Philadelphia Journal of the Medical and Physical Sciences.

without feelings of the deepest mortification, the inefficiency of medicine exemplified in the ravages of consumption? To limit our examination to the year which has just elapsed, we shall perceive that one-sixth part of the mortality in the four largest cities of the United States is the result of this disease.

Where, then, the object in view is of such immense importance, no labour will be considered useless which can elicit any light. And whether we are destined to hail this new article as a useful addition to our means of cure,—or whether we are doomed once more to witness the fallacy of our hopes,—a decision grounded upon satisfactory evidence is much to be desired. For if it becomes our imperious duty to avail ourselves of every assistance which recent discoveries may afford us, it is no less important to investigate, by careful experiments, the properties of the substance which is proposed. This is unquestionably the only positive mode of ascertaining what value we are to give to the enthusiastic encomiums of an author, not unfrequently biassed by a love of the wonderful, and generally disposed to view his favourite remedy in that light only which can support his particular theory. Experience must have convinced even the youngest practitioner, that this conclusion is fairly deduced from the many disappointments we incur in relying too implicitly on the results we daily find recorded in medical works. Though it is not intended to convey the idea that willing deception is practised, still the effect is equally prejudicial to the interests of medicine; and certainly we are justified, after numerous unsuccessful trials, in expressing some doubts as to the correctness of their results, while making all due allowance for climate, idiosyncrasy, habits, &c. It matters little to the practitioner, condemned to witness the fruitless exhibition of a medicine extolled as a never-failing specific, whether he has been misled by the enthusiasm alone of the author of it, or by his want of candour in relating every circumstance liable to affect its operations. Whoever reads with

attention the European works on medicine, and more especially those on its practice, must be astonished to perceive how widely we differ from them in the single article of doses: nor does it appear to me easy to understand why a similar dose of medicine should produce one effect in London or Paris, and give rise to an entirely different result, under similar circumstances, in Philadelphia. To confine my observations to two of the most recent articles, I will mention the prussic acid and nux vomica, both powerful agents, but, owing probably to the misrepresentation of some circumstances, have lost much, in this city at least, of the high reputation with which they were received. The former of these articles has, however, been subject to an objection which may strongly affect its use here; that is, the rapidity with which it is decomposed. This difficulty is now nearly done away, as I shall state hereafter. It only remains to ascertain by experience what are its medical properties. With the view of arriving at truth by the only safe path, and of accounting, if possible, for the disuse or neglect into which the first of these remedies has already fallen, I have prescribed it in a number of cases, the result of which is fairly and candidly detailed in the following pages. Of the efficacy of nux vomica, in several forms of diseases, I trust it will soon be in my power to publish satisfactory evidence.

Dr. Majendie, whose name is familiar to all those who have taken an interest in physiological experiments, has enjoyed, until quite recently, the credit of having first suggested the use of prussic acid in phthisis. Dr. Benjamin L. Oliver, a practitioner of medicine at Salem, in Massachusetts, has, however, asserted his claim to the priority of this idea; and in the Fourth Number, ninth volume, of the New-England Journal of Medicine and Surgery, he has satisfactorily proved, that, as early as the year 1811, he had administered this medicine to one of his relations. Whether Dr. Oliver is entitled to the merit of this discovery or not, it is no less true, that to Dr. Majendie are the Profession

indebted for the attention which this powerful agent has lately attracted.

The latter gentleman, for whose veracity and correctness I feel competent to vouch, from personal acquaintance, informs us, that, having observed that animals poisoned by prussic acid, and entirely deprived of sensibility and motion, preserved for several hours a free respiration, and a circulation apparently uninjured, although much quickened, conceived the idea, that this substance might diminish general sensibility, without injuring respiration or circulation; and therefore could perhaps be employed with advantage in those diseases arising from an increased morbid sensibility. Experience has proved, that, in some cases, this conclusion was a just one; and, further, that although its action on the nervous system, and on the blood, is similar to that of opium, yet that it differs essentially from the latter in its sudorific qualities.

Dr. Majendie has accordingly prescribed this medicine in a number of cases of catarrhs, recent and chronic; and also in phthisis;—in the majority of them with advantage. At his request, two other eminent physicians of Paris, Drs. Recamier and Lerminier, attached to the two first hospitals of that capital, have also administered it, and with results equally beneficial.

Dr. Granville, of London, has been no less successful in his exhibition of this medicine; and, in his publication, recommends it as a valuable remedy in pulmonary affections.

From his testimony, it would appear that no medicine hitherto used in phthisis had afforded such permanent relief. And finally, from the united experience of Drs. Majendie and Granville, it is satisfactorily established, that the prussic acid, given in moderate doses and properly diluted, has by them been advantageously employed as a palliative in the treatment of phthisis, with a view of calming the cough, facilitating expectoration, and procuring sleep; and from these properties, those gentlemen consider it entitled to the first rank among the medicines usually

prescribed with these expectations. Nay, they even indulge the hope that it will prove not only a palliative, but a radical cure; and this opinion, however chimerical it may appear to those who have attended closely to phthisis, is illustrated by several cases, which are fully detailed in the papers I allude to.

Subsequent to the publication of Dr. Granville's memoir, another on the same subject, by Dr. Elliotson, of London, has made its appearance. Its perusal has afforded me a new instance of the anomalies with which the history of medicine abounds. The author, who appears to have bestowed considerable attention on this subject, declares positively that in no case of phthisis has he ever derived *any* benefit from the acid, as a permanent remedy; and, therefore, that it is to be added to the list of medicines that have been fruitlessly tried to cure consumption. He admits, however, that in certain cases it may allay the cough, and even has a tendency to diminish night-sweats. Yet this concession is only made on the conditional admission, that these effects are the result of a sympathetic action, through the medium of the stomach. But he recommends its use in chronic catarrhs, nervous coughs, simple dry cough, and hooping-cough. It is in cases of dyspepsia, and indeed in all the affections of the stomach accompanied with pain, that he recommends it as an invaluable remedy.

Dr. Elliotson's publication, dated July 1820, and which contains many very useful facts in relation to the effects and powers of prussic acid, is the latest European publication I have seen.

The reputed virtues of this substance could not fail to attract the attention of the Profession in this country; but in no section of the United States has it met with such general encouragement as in the Eastern States. The Paper of Dr. Majendie has been translated by Dr. Percival, of New-Haven; and several respectable practitioners have recorded, in the last Number of Professor Silliman's Journal, the result of numerous trials. These have generally been

favourable, and are highly calculated to encourage those who may wish to examine its medical properties.

I am far from being convinced that it has received in this city that attention which its reputed virtues should have called forth. In fact, but few of our physicians have as yet prescribed it; and those cases wherein it has been directed, are so few as not to form any satisfactory evidence of its powers.

The high opinion I have long entertained of Dr. Majendie, and my implicit reliance on the correctness of his results, induced me, soon after the reception of his Paper, to undertake the repetition of his trials. It was by this method alone that I could satisfy my own mind as to the effects of this very powerful agent, concerning which so great a discordance of opinion already existed.

CASE I.—The first case which appeared to me likely to test its efficacy, was that of Mrs. H., a patient of the Philadelphia Dispensary, aged about 45 years, and who was at that time labouring under symptoms of confirmed phthisis. She had tried in vain many remedies, before her admission to the care of the Institution. After resorting to the usual ineffectual modes of treatment, I had recourse to Dr. Majendie's plan, and prescribed the acid. It had been prepared with care, and was recommended to me as being precisely of the same strength as that used in Europe. Two drops were directed to be taken in pure water each day; and the dose to be gradually increased, until the patient, in the course of one week, had reached the dose of ten drops daily. Yet no visible effect was perceptible: not only was no amelioration observed, but neither the constriction about the chest, nor head-ache, which are mentioned as frequently attending its exhibitions in such large doses, were complained of. At the end of the second week, the dose had been increased to about thirty drops daily, without producing any effect whatever. I now felt discouraged: but having procured a quantity of fresh prepared acid, I had an opportunity of testing its strength.

Two drops were put on the tongue of a kitten two weeks old: it was immediately seized with convulsions, and in about four seconds expired. The patient now began its use in doses of two drops daily for three days; then increasing in the ratio of three drops daily, until she took thirty drops in the twenty-four hours. At this period I could find no visible alteration; and with reluctance abandoned, in this case, the use of the medicine.

The instance of Mrs. H., who was an extremely irritable and nervous woman, and whose disease was complicated with asthma, could not be deemed a sufficient trial, even admitting it to be a fair one; and consequently was in no ways likely to affect the question of the efficacy of the medicine. I soon found, among the patients of the Dispensary, a case which afforded some rational hope of success.

CASE II.—John C., aged about 53 years, of a strong and muscular appearance, working in a brick-yard, had been troubled, for about two months in August 1819, with continual pain in the chest, dyspnœa, and cough, accompanied with some expectoration of a doubtful nature. The pain in the chest induced me to direct the loss of about fourteen ounces of blood; and, immediately after, he began the use of the acid, in daily doses of four drops, increasing two drops every day, until he had taken twenty-four in a day. He now informed me that his cough was somewhat better; and that his sleep, which had been very much disturbed by unpleasant dreams, and otherwise agitated, was more tranquil. The dose was continued thus for a few days; and then increased four drops daily, until the patient took daily thirty-six drops. The benefit derived had increased; his cough was better, and his sleep continued composed. The medicine was now at an end, and this case terminated here. It is, however, proper to mention, that I have seen him a month ago, still affected with slight cough, but which is considerably diminished. He is now enabled to pursue his work. I conclude, therefore, that in this case the prussic acid has been of some use.

CASE III.—In November last, Robert N., a patient of the Dispensary, aged about 36 years, of a slender form, and by trade a carpenter, applied for medical assistance. He complained of a pain in the chest, great difficulty in breathing, or, as he expressed it, a shortness of breath, a dry cough, no expectoration, and occasional chills and night-sweats. His pulse was tense and frequent. These symptoms had been gradually increasing for about six months, during which time the patient had lost considerable flesh. After taking, for a few nights, the ipecacuanha and opium combined, he began the use of the acid. At first he took it in very small doses, owing to the impression I was then under that its effects would be very powerful. But the second prescription, November 28th, contained thirty drops in four ounces of water, edulcorated with gum-arabic and sugar. The patient was directed to take a table-spoonful of the mixture three times each day; and he soon felt some amelioration in his feelings.

December 2d, the mixture being out, a new one, containing ʒij prussic acid in the same vehicle, and accompanied with the same injunctions as to its doses, was directed. It was followed by increased benefit.

December 7th, one drachm of the acid in three ounces of water, edulcorated with gum-arabic and sugar, which the patient is to take in table-spoonfuls every third hour. Robert states that his cough is considerably diminished.

December 13th, the same prescription is renewed with manifest advantage.

December 18th, one drachm and a half in six ounces of water is prescribed to be used, in the same doses and at the same intervals. The patient continues improving. At no period since its first exhibition has he mentioned either nausea or head-ache.

Robert continued under the operation of the acid until the 20th of January, and then used, as a substitute and general tonic, the cold infusion of bark. His cough has nearly left him; and his appetite, appearance, and general

feelings are about the same as previous to the invasion of the disease. He is discharged from the care of the Institution, and is now pursuing his trade.

CASE IV.—Mary P., aged about 22 years, had been affected for about three weeks with the usual symptoms of incipient phthisis, and pronounced to be affected with that disease by a respectable physician, who had visited her previous to my attendance. When I first called on her, on the 11th of February, I found the patient confined to her bed with continual fever, and a small, quick, and tense pulse. She had already used in vain several pectoral mixtures, and took, according to my directions, a fresh one, containing balsam tolu; but without deriving from either any relief whatever. Accordingly, very soon after my attendance commenced, the prussic acid was administered, in doses of one drop to the ounce of water, which doses were very soon increased. She is now taking it in doses of sixteen drops to four ounces of water,—a table-spoonful every two hours. Without exhausting your patience, Gentlemen, with details, which, by their repetitions, may be tedious and uninteresting, I will merely state, that my patient is rapidly improving; so much so, that this day, the 11th of March, she informs me that she has not coughed more than twice or three times in the course of the last twenty-four hours. She is now sitting up, and has already acquired some flesh, and a slow and rational pulse.

Besides the cases already related, there are three others under care; but they are of too recent date to form at present any satisfactory conclusion. A suspension or a mitigation of some of the symptoms of a disease for a few hours, or even days, should never be admitted as positive testimony. It becomes proper, however, to state, that the patients are all under the impression that they derive benefit from this medicine.

It may, perhaps, be expected, that, in concluding these remarks, something should be offered tending to explain the modus operandi of the article under consideration.

But, besides the want of sufficient experience to support the reputation which this new medicine has been supposed to deserve, no facts explaining its action, of a satisfactory nature, have as yet been offered by those more immediately concerned in its success.¶ It has been compared to opium in some points of view, and it does appear to possess some sedative properties. That it acts in some cases by occasioning vertigo, head-ache, and a slight stricture acros the chest, must be admitted; but these are merely temporary effects, and of very rare occurrence. In my limited circle of observation, I have not witnessed the alarming symptoms related by Dr. Majendie; nor have I so far been enabled to produce those very agreeable sensations which Dr. Granville informs us were visible in some of his patients.

Diffident, however, of my own results, and therefore particularly anxious that some of my colleagues should add confirmation to the facts herein stated, I have thought the following remarks not altogether uninteresting to those who may feel disposed to use this medicine.

There are several modes of preparing the prussic acid, three of which are recommended in the French codex, under the names of Scheele, Gay Lussac, and Vauquelin. The two latter are much stronger than the former; but all three lose their properties by exposure to light and air, in a very short time. To obviate this very serious objection, Dr. Cooper has prepared a solution of this acid in alcohol, and in this form it certainly is much more easily preserved than the other preparations. It would appear, however, that it is still subject to a slow decomposition, from the circumstance of its peculiar flavour, resembling that of bitter almonds, decreasing after being kept for a couple or three weeks; and therefore it becomes desirable that it should be renewed as often as possible.

I have used this last preparation in most of the cases referred to in these remarks. In no case has its bad effects been produced, although used in large doses. For instance, I am in the habit of prescribing it in the proportion of one drop of the acid to an ounce of water, a table-spoonful of

the mixture to be repeated once, twice, or oftener, as it may be judged requisite, in the course of the day. In the case of Robert N., a mixture containing one drachm and a half of the acid in six ounces of water, was directed to be taken by table-spoonfuls every third hour, and the patient was evidently benefitted by its use. Yet this is but one case, and should not be considered as conclusive evidence in favour of such large doses: for my very worthy and experienced friend, Dr. Monges, of this city, informs me, that he prescribed this same article in a case of calculous phthisis, a short time since; and that doses of one sixteenth part of a drop, occasioned such an increase of the cough, and consequent irritation, as to induce him to abandon its use. He observed at the same time, that, in this instance, the particular circumstance of small portions of calculi being expectorated, perhaps in a more rapid manner in consequence of the exhibition of this medicine, may have prevented its beneficial effects.

One inference appears fairly deduced from the above facts; and that is, that we should receive with due caution the opinion contained in Dr. Elliotson's Paper*, when he affirms that he does not hesitate to prescribe the acid for patients whom he has not an opportunity of seeing more than once a week, or who perhaps reside in the country. With an agent endowed with such powerful properties, it certainly would seem to require more circumspection than can be exercised under such circumstances.

If any additional motive could be required, to warn the Profession from too hasty an adoption of either of the opposite conclusions contained in the Papers referred to, without further experience on so interesting a subject, it will be found in a reference to the history of other medicines, which have had their day, and which have also been proposed with the hope of averting this scourge of the human race. Many of these, apparently gifted with powerful properties, and supported by the enthusiastic encomiums of highly respect-

* Elliotson on Prussic Acid, p. 40.

able names, have nevertheless not been found capable of standing the test of practical experience, and have accordingly already been deprived of their short-lived reputation and ill-deserved fame.

LX.—*A Case of Epistaxis successfully treated by Immersion. Communicated in a Letter from* JAMES KENT PLATT, M. D. *Member of the College of Surgeons, London, to* JOHN B. BECK, M.D. *of New York.**

BELIEVING, with an elegant writer, that "examples are eloquent," I am induced to transmit to you the following instance of the benefit of immersion in epistaxis. It is in physic as in morals, we do not need the inculcation of new precepts, so much as we do to be reminded of our duty to practise those which already exist. I am aware there is nothing novel in the *application of cold* in the disease I have mentioned; for its salutary effect in the restraint of hæmorrhage, is as well established as any principle in medicine. My object is to shew that it will be found effectual when carried to the extent here employed, though it frequently disappoints our hopes when it is but partially used. I have met with no writer who recommends immersion, and I would not be understood to advocate its unguarded or indiscriminate use†. Many cases require no professional aid: others may be readily imagined, wherein the powers of life might be so far depressed, or the lungs so irritable, as to render the production of rigors hazardous and unwarrantable. Whenever the cold bath is employed, the patient should continue in it a considerable time; as otherwise the re-action would probably be so great, as not only to defeat our intention, but actually to change

* From No. IV. of the Philadelphia Journal of the Medical and Physical Sciences.

† The late Dr. Thomas Bond, a physician of this city, remarkably distinguished by the originality and boldness of his practice, was in the habit of using the bath in all hæmorrhages, even those of the lungs.—*American Editor.*

the character of the remedy, and aggravate the very symptoms we wish to relieve.

In a disease like this, when the bleeding has continued until the patient is well nigh exhausted, and every bystander is filled with alarm and dismay, it is impossible to suggest any practice which will not require the steady exercise of a firm and well-disciplined mind; yet I conceive no greater danger will accrue from the use of cold by immersion, in the hands of the unwary and inexperienced, than of any other energetic constitutional remedy. It has been customary in extreme cases of epistaxis to apply compression to the bleeding vessels, by a dossil of lint, introduced through the posterior nares, after the method of Le Dran: but setting aside the natural repugnance which most people have to any thing like a surgical operation, and the ordinary inconvenience attendant on the procedure, instances occur in asthmatic patients, when the irritation of the fauces, by ligatures, &c. causes so much difficulty of respiration, as to impede seriously the execution of the plan. In such cases, I should advise immersion, if on trial the common means had failed; unless circumstances existed strongly condemning its use.

Yours truly,

JAMES KENT PLATT.

September 11th, 1820, an extremely warm day, I was called, about two o'clock P.M., to Major J. Walworth, aged thirty-six years, of the sanguine temperament, with a very plethoric habit, and short neck. He had been seized two hours before, after severe exercise, with bleeding at the nose, and it still continued in almost an uninterrupted stream. His pulse was weak, his skin cool, and he felt languid and faint. Venesection had been employed, agaric and other styptics applied, and both nostrils filled with dossils of lint, wet in a solution of alum. These had no other effect than to turn the stream down his throat, to excite irritation in the fauces, and produce expectoration,

Ice had been applied to the head, back of the neck, axilla, &c. with no better success.

The patient had now lost, it was estimated, more than four pounds of blood, and it seemed expedient to adopt some energetic mode of treatment. On consultation with Dr. Mooers, it was determined to immerse him in a bath of well water, until an ague should be produced. This effect took place in about a minute after his immersion; and the rigors continued a few minutes after his removal, to the degree, that he shook as if in the cold stage of a severe intermittent. The happiest success attended the experiment: the hæmorrhage abated before he left the bath, soon ceased entirely, and did not recur.

He was ordered to be kept cool, the ice-water was to be continued on his forehead and scrotum, to be cautious not to disturb the coagula in his nostrils, to take repeated doses of nitre, and to observe the strictest abstinence and quiet.

8 P. M.—His pulse has risen, and skin become warm; he breathes through his mouth only; and being asthmatic, from corpulency, his system appears considerably irritated from the obstruction in his nose. The purging salts in common use having, on former occasions, proved offensive to his stomach, and considering it important to prevent vomiting, I ordered him to drink freely of cream of tartar, and to continue the former directions.

Sept. 12th.—The laxative has affected him, the febrile symptoms have subsided, and he breathes through one nostril.

13th.—The coagula are loosened, he breathes well, has experienced no catarrhal affection from the bath—is convalescent.

Plattsburgh (N. York), Jan. 15, 1821.

LXI.—MISCELLANEOUS.

On the Use of Coal-Tar. *By* H. C. JENNINGS, *Esq.* In a Letter to the Editor.

6, Nottingham Street,
28th March, 1822.

SIR,

HAVING, at the request of Joseph Hume, Esq. M.P., assisted Mr. Good in making some experiments at Mill Wall, Poplar, on Saturday the 23d inst., to endeavour to prove the injurious effects of injecting coal-tar into the timbers of ships of war, to prevent the dry rot, (the plan of Sir Robert Seppings, one of the Surveyors of the Navy,) I beg leave to state, that the whole of the experiments, as relate to its destroying the wood, copper, and iron-fastenings,—and its explosibility by red-hot shot, the flash of a pistol, or the contact of flame,—were entirely defeated and disproved, by the most irrefutable and satisfactory evidence; to which, out of above fifty naval and scientific persons, besides Members of Parliament, there was but one dissenting voice; namely, that of Mr. Good, the proposer of the objections; to whom the old adage strictly applies—

> " He that's convinc'd against his will
> Is of the same opinion still."

It is but a fair and candid tribute to Mr. Hume's conduct to state, that he desired me to use every caution in the fair conduct of the above experiments; so that no advantage should be taken, to bear out the charge made against a practice said to be so injurious to the best interests of the country. And it is also necessary to state, that the Commissioner of the Navy, Sir Byam Martin, and Sir Robert Seppings, behaved in the most open and liberal manner.

The whole of the spectators were invited on board the Russell, on the stocks, a new ship that had been injected with the coal-tar; and Mr. Good was provided with the

means of setting fire to the ship, both by gunpowder and flame. It need hardly be added, that his attempts to do so were entirely vain and fruitless: in fact, he could not set the ship on fire by any fair or ordinary means.

Sir Robert Seppings described to us the whole of his recent improvements in ship-building, and in preventing the dry-rot; and I hope and trust the day is not far distant, when his benevolent and scientific plans will be generally adopted in all classes of ships, wherever His Majesty's subjects are destined to expose their lives and property.

As to the objection which Mr. Good made, of the probability that the vapour arising from coal-tar would injure the health of the seamen, the fact has been already set at rest, by the returns laid before the Navy Board of His Majesty's ship Owen Glendower, a ship most fully saturated with coal-tar; having in two years, on a sickly station, lost only two men, and those by common diseases. In fact, having known the gas from the oil of coal-tar prescribed in phthisis pulmonalis (consumption) with the most decided advantage in numerous cases, I am prepared to say, that a moderate proportion of the vapour of coal-tar is beneficial, rather than hurtful: but on board the Russell, the vapour disengaged was not enough to do good, much less harm.

This vapour increases the appetite, and destroys putrid miasmata: it is useful in every situation where animal or vegetable matter is suffering spontaneous decomposition, as it neutralizes the gaseous fluids liberated from such substances.

Having had a violent prejudice against the plans adopted by the Navy Board, from the invidious reports of persons who either ignorantly or wilfully misrepresented the process and results, I am only now doing an act of justice in giving publicity to this statement of facts; whereby I relieve my own mind, and pay a just tribute to the merit I was before, from a false and mistaken zeal, too ready to have opposed.

I am sure you will be equally ready and disposed to give effect to these useful and patriotic plans, through the medium of your valuable Repository.

I am, Sir, your most obedient humble Servant,

To the Editor of the Technical Repository. H. C. JENNINGS.

On French Steam-Boats, and the Navigation of the Seine.
By a CORRESPONDENT.

THE following extract of a Letter from a friend of the Editor's, residing in Paris, dated in June last, furnishes some interesting particulars on this important subject:—

"A new steam-boat, called the Duke of Bourdeaux, equipped at Rouen with machinery from England, ascended the Seine, and arrived in Paris, June 11, for the first time; her engine working thirty-seven hours. She descended to Rouen on the 13th in seventeen hours. She arrived again in Paris on the 20th, with a freight of 100 tons; which, at fourteen shillings per ton, is 70*l.* sterling; her engine working forty-seven hours. But she was, in both her trips from Rouen to Paris, three days each; and for this reason—No large boats are allowed to pass the bridges without a pilot; and, moreover, the bars and shoals in the bed of the river are continually changing and shifting, which makes it so very hazardous to work in the night, that they always then lie still.

"This boat is one hundred and twenty feet long, fourteen feet wide, and draws, when loaded, three feet six inches. Its water-wheel runs on three out-riggers fixed at the stern of the vessel: the middle out-rigger divides the wheel (but not its axis) into two parts. The wheel is all iron, and without rims, these being supplied by right-lined braces: it is ten feet in diameter, and occupies the whole breadth of the stern: it receives its motion from the engine at the middle out-rigger, by means of a spindle, which is forty feet in length. The engine is a Watt and Boulton's, of ten-horse power; has two boilers, and yet occupies

a space of only twenty feet. The boat has two rudders; one at the head, and one at the stern.

"From Rouen to Paris, by land, is ninety miles; and by water, one hundred and seventy-five. The performance of this boat is thought so very extraordinary in France, that the proprietors have already contracted for the building of two more, under a firm persuasion that the great difficulties hitherto experienced in steam navigation on this river may be thus overcome.

"The common motion of the current of the Seine is stated, in the Paris Guide, at twenty inches per second. The passage of the large boats, drawn by horses, from Rouen to Paris, is usually fifteen days."

In another Letter from the same Correspondent, he says: "A machine, such as is used for raising of ballast on the Thames, and for clearing the canals in England, worked by steam, has been imported from thence to Paris, with English workmen to put it up; and is designed to remove the shallows that obstruct the navigation of the Seine."

It is to be hoped that this machine will be found to remove some of the obstructions, at least, which have hitherto so much impeded the navigation of this river.

We are, however, of opinion, from the following observations, contained in a former Letter of our Correspondent's, that there are unsurmountable objections to the extensive use of steam-boats upon the Seine; viz.

"The distance from Havre, at the mouth of the Seine, to Paris, is much greater than from Gravesend to London; and the Seine has in it a great number of islands, some of which are a mile or more in length: these obstructions, with the weight and rapidity of the stream, prevent the tides from being felt more than half the way. Besides, its meanders in the rich and capacious valleys through which it flows, make the distance by water nearly twice as much as that by land.

"The navigation of this beautiful river, from Rouen to Paris, is performed in flat-bottomed boats of great length

and breadth, which are warped by men, or towed by horses. I saw at Mantes ten horses, in two ranks, labouring very hard, and to little purpose; and told the driver that he required six more. 'Tis true,' said he; 'but this spring (1819) there has been no dissolved snow nor rain to fill the river; which is a very great loss, as we can take only half a cargo; therefore we cannot afford more horses.'

"From this short notice of the river Seine and its navigation, you must nesessarily conclude that it is not calculated for boats to be driven by steam. Yet four steam-vessels have been built for the purpose; two of which are now lying at Rouen, and two at Paris; but they are all for sale, having proved a most unfortunate speculation."

On Purifying the Water of the River Seine at Paris.

An extract from another Letter of the same Correspondent contains the following particulars on the above important subject:—

"There is a patent Institution, in this city, for purifying, for domestic use, the water of the Seine; which gives constant employment to upwards of two hundred persons. The water is pumped into vessels about twenty feet deep, and as many in width, where it reposes twelve hours: the clear water is then raised into another vessel, from whence it flows into long and shallow cisterns; in the sides of which a great number of sponge filtres are placed, and the sponges are renewed every hour. From the sponge filtres it finds its way into square shallow cisterns; each of which has, at the bottom, a bed of clean Fontainbleau sand, then a bed of pounded charcoal, then another bed of clean sand, and, lastly, at top, a bed of coarse river-sand (these last-mentioned filtres are renewed every six hours); and this is the last operation previous to its distribution.

"They seem to take a pleasure in shewing the whole of these respectable works to strangers. Four horses are constantly at the pumps; which obliges them to keep twelve for this purpose. I asked the superintendant why they

had not a steam-engine? 'The proprietor,' he said, 'had inquired the cost of such a machine, but the dearness of fuel forbade its use.' "

REWARDS

Voted by the Society for the Encouragement of Arts, Manufactures, and Commerce, in the present Session.

To Mr. E. Richards, of Bethnal Green; for his Improvements on Drawboys and Looms for Silk-weaving—the sum of Fifteen Guineas.

To Mr. J. Hughes, of Bethnal Green; for similar Improvements—the sum of Five Guineas.

To Mr. G. Holditch, of Lynn, Norfolk; for his Method of fixing Life-beacons on Sandy Shoals—the Silver Medal, and Ten Guineas.

To Mr. W. Gossage, of Chesterfield; for a cheap Watch-Alarum—the sum of Five Guineas.

To Mr. J. Millikin, Surgeons' Instrument Maker, Strand; for an improved Sheathed Bistoury—the Silver Medal.

To Mr. J. Watson, Burlington Arcade; for his new Method of teaching Music to the Blind—the Vulcan Silver Medal.

To Mr. S. Marshall, of Merton Abbey; for his new Blocks for Calico Printing—the sum of Fifteen Guineas.

To Mr. C. Goodwin, London Wall; for his improved Bridle-bit—the Silver Medal.

To Mr. John Parry, London; for manufacturing Plat for Hats from Leghorn Straw—the Silver Medal.

To Mr. W. H. Reveley, London; for his Communication on Tuscan Mill-stones—the Silver Medal.

To Mr. R. Thom, of the Rothsay Cotton Mills, for his Hydraulic Apparatus—the Silver Medal.

To Captain H. Gordon, Royal Navy; for converting a Ship's Boat into a Life-boat—the Vulcan Silver Medal.

To Messrs. Cowley and Staines, Winslow, Bucks; for cultivating the White Poppy, and extracting Opium from

the same—the Premium of the Gold Ceres Medal, or Thirty Guineas.

To Mr. R. Pering, Royal Dock-yard, Plymouth; for his Wrought-iron Carriage for Ships' Guns—the Vulcan Silver Medal.

To J. M'Arthur, Esq.; for Importing fine Sheep's Wool from New South Wales—the Premium of the Gold Medal.

To the same; for the finest Sample of Wool from New South Wales—the Premium of the Gold Medal.

To J. Raine, Esq. London; for importing Wool from Van Dieman's Land—the Ceres Silver Medal.

To Mr. W. Meigh, of Shelton, in the Staffordshire Potteries; for his Glaze for common Earthen-ware—the Premium of the Gold Medal, or Thirty Guineas.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since February 23, 1822.

To William Erskine Cochrane, Esq. of Somerset Street, Portman Square, in the county of Middlesex; for his improvements in the Construction of Lamps, whereby they are rendered capable of burning Concrete Oils, Animal Fat, and other similar Inflammable Substances. Dated February 23, 1822.—To be specified in six months.

To John William Buckle, of Mark Lane, in the city of London, Merchant; in consequence of a communication made to him by John Parker Boyd, of Boston, in the United States of America; for certain improvements in Machinery for shaping or cutting out irregular Forms in Wood, or any other Materials or Substances, which admit of being cut by Cutters or Tools revolving with a Circular Motion, whether such motion be continuous or reciprocating. Dated March 2, 1822.—In two months.

To John Higgins, of Fulham, in the county of Middlesex, Esq. for certain improvements upon the Construction of Carriages. Dated March 2, 1822.—In six months.

To Charles Yardley, of Camberwell, Glue Manufacturer; for a new method of Manufacturing Glue from Bones, by means of Steam. Dated March 2, 1822.—In two months.

To John Thompson, of Regent Street, Westminster, and of the London Steel Works; for certain improvements in the method of forming or preparing Steel, for the Manufacture of Springs for Carriages; but principally applicable to all those usually denominated Coach-Springs. Dated March 2, 1822.—In two months.

To John Ruthven, of the City of Edinburgh, Printer; for his new method of procuring a Mechanical Power. Dated March 2, 1822.—In four months.

To George Stratton, of Hampstead Road, in the county of Middlesex, Engineer, for his improved Process of Consuming Smoke. Dated March 2, 1822.—In six months.

To James Gladstone, of Liverpool, in the county of Lancaster, Ironmonger; for a Chain of a new and improved Construction. Dated March 12, 1822—In six months.

To Robert Bartlett Bate, of No. 17, Poultry, in the city of London, Optician; for certain improvements upon Hydrometers and Saccharometers. Dated March 21, 1822. —In two months.

To William Eugene Edward Conwell, of Madras, in the East Indies; but now residing at Ratcliff Highway, in the parish of St. George in the East, in the county of Middlesex, Surgeon; for his improvement in the Preparation and Application of a certain Purgative Vegetable Oil. Dated March 21, 1822.—In six months.

To Samuel Robinson, of Leeds, in the county of York, Cloth-Dresser; for certain improvements on a Machine for Shearing and Cropping Woollen Cloth. Dated March 21, 1822.—In two months.

To George Stephenson, of Long Benton, in the county of Northumberland, Engineer; for certain improvements in Steam Engines. Dated March 21, 1822.—In two months.

To Richard Summers Harford, of Ebbw-Vale Iron-Works, in the parish of Aberystwith, in the county of Monmouth, Ironmaster, being one of the people called

Quakers; for his improvement in the Heating Processes in the Manufacture of Bar, Rod, Sheet, and other descriptions of Malleable Iron; whether the same may have been previously prepared by the Puddling, or other modes of refining. Dated March 21, 1822.—In four months.

To William Church, of Nelson Square, in the county of Surrey, Gentleman; for his improved Apparatus for Printing. Dated March 21, 1822.—In six months.

To Alexander Clark, of Dron, in the Parish of Louchars, in the County of Fife, North Britain, Esquire; for his improvements in the Boilers and Condensers of Steam-Engines. Dated March 21, 1822.—In six months.

THE

TECHNICAL REPOSITORY.

LXII.—*Specification of the Patent granted to* JAMES SMETHURST, *of St. Margaret's Hill, Southwark, in the County of Surrey, Lamp Manufacturer and Contractor; and* NICHOLAS PAUL, *of Villiers Street, Strand, in the County of Middlesex, Mechanician; for certain Improvements applicable to Lamps and Reflectors.—Dated 30th Oct.* 1802. *Term expired.*—[Concluded from p. 243.

WITH A QUARTO PLATE.

HAVING thus described, generally, the leading objects of our improvements, and given the most full and explicit details respecting such of them as relate to the construction of the lamps themselves, it remains for us to shew the geometrical construction of the forms of the reflectors, so that they may answer the purpose for which they are intended; to wit, that of so reflecting, diffusing, and distributing such rays of the light, produced from the flame of the lamp, as would otherwise be useless, or as many of them as possible, so that the surface, or extent of space to be illuminated, may be as uniformly illuminated as may be. The particular mode of effecting this depending, of course, on the particular form and dimensions of every such surface or extent of space to be illuminated, all that can be done is, to lay down, as perspicuously as possible, the principles on which the reflectors are formed in all cases, and then give some examples of the application of these principles in the most ordinary instances. Let L, fig. 1, in the annexed drawing, No. VI., on Plate XVIII., represent the flame of the lamp; A, B the extent

of a surface or space to be illuminated (which we are in the present instance supposing to be a horizontal plane); R, Q the convenient extent or dimensions of a reflector, which may be applied to the lamp L, so as to intercept those rays of light which would otherwise fall in a direction in which they would be useless, or as many of them as may be; R being the nearest, and Q the farthest, convenient distance of any part of the reflector from the flame of the lamp L.—Now, according to the principles already laid down, those rays of the lamp which fall on R, the nearest point of the reflector, are to be directed to B, the most distant point of the surface, or extent of space, to be illuminated; and those which fall on Q, the farthest point of the reflector, are, on the other hand, to be directed to A, the nearest point of the surface, or extent of space, to be illuminated, or directly under the lamp. Draw, therefore, L R, and L Q, and R B, and Q A. Now, as the angles of incidence and reflection are equal, it is manifest, that if we draw through R a right line, $p\,q$, and through Q another right line $a\,z$, so that the angle L R p may be equal to the angle B R q, and the angle L q a equal to the angle A Q z, the said right lines $p\,q$ and $a\,z$ will be tangents to the curve of the reflector, at the respective points R and Q. Draw, therefore, the right lines $p\,q$ and $a\,z$, in this manner accordingly; and their directions coinciding with those of the curve of the reflector at those points, the latter are consequently given. Now, in order to ascertain the direction of the curve of the reflector at a convenient number of intermediate points (as for instance, four), and be thereby enabled to trace the proper curve through those points, draw as many right lines L S, L U, L W, and L Y, so that the angles R L S, S L U, U L W, W L Y, and Y L Q, may be equal to each other, or so that the whole angle R Q L may be divided by the lines L S, L U, L W, and L Y, into equal parts. Divide the right line A B, into equal parts, at as many intermediate points between A and B (as in the present instance, four), C D E and F; and draw S F, U E,

W D, and Y C. Draw also the right lines *r s*, *t u*, *v w*, and *x y*, through the respective points S, U, W, and Y, so that the angle *r* S L may be equal to the angle *s* S T, the angle F U L equal to the angle *v* U E, the angle *v* W L equal to the angle *w* W D, and the angle *x* Y L equal to the angle *y* Y C; and the respective right lines, *r s*, *t u*, *v w*, and *x y*, so drawn, will respectively coincide with the required curve of the reflector R Q, at those respective intermediate points, S, U, W, and Y, through which the required curve R Q may be accordingly easily traced by hand. If we are to suppose the whole surface or extent of space, on being illuminated, to be circular, or equally extended to every side of the lamp, then it is obvious that the reflector must be of a figure which would be generated by the revolution of the curve R Q, about L R as an axis, as in the case of the circular reflector Q, fig. 1, in the annexed drawing, No. IV. If, on the other hand, we are to suppose that the space to be illuminated is of such a nature that it is only desirable that the rays should be reflected in the direction or towards the side B of the lamp, then the proper form of the reflector will be that of a kind of hood or bonnet, formed by the revolution of the curve R Q about the line L B as an axis, as in fig. 5, in the drawing No. III. Having thus formed a pair of solid patterns, or dies, of the proper form; to wit, one for the exterior or convex surface, and the other for the interior or concave surface of the reflector; they are to be struck off with a proper fly press, in such manner as is already frequently used for reflectors of different forms, and in a great variety of analogous operations, in which thin plates of metal (as coffin-plates) are struck into convex, concave, or embossed or enchased forms. In the said annexed drawing, No. VI., Q, Q, fig. 2, represents a section of such a circular reflector as is already described at fig. 1, No. II., and fig. 1, No. IV., and which is here supposed to be applied to one of Smethurst and White's patent lamps, as in the latter of those two figures. In the present figure, the several lines marked *a*, *a*, *a*, &c.

represent the direct rays of the lamp as issuing from the flame A. *c*, *c*, *c*, &c. those rays of the lamp which are incident on the reflector, Q, Q; and *d*, *d*, *d*, &c., the course or direction of the same rays after reflection; from which it will be seen, that those which are incident on those parts of the reflector which are nearest to the flame are reflected to the greatest distance, and *vice versâ*.

Q, Q, fig. 3, in the same drawing, represents a section of another circular reflector, analogous to the former, but which differs from it in being calculated for the illumination of a circular space of limited extent; so that the distance to which it reflects the most distant rays is also limited, and the degree of illumination on such limited space consequently increased.

In fig. 4, in the said drawing, *m n*, *m* 1 *n*, *m* 2 *n*, and *m* 3 *n*, represent four sections of different reflectors of degrees of curvature, according to the extent of this limitation.

Q, Q, fig. 5, in the same drawing, represents a section of a reflector, which is so constructed as to reflect the rays nearly perpendicularly, but rather in a converging direction; and which is applicable to such lamps as are intended to be suspended at the top of well-staircases, or in similar places. In this case, no glass dome or chimney is absolutely necessary, but a short metal chimney F is applied to the top of the reflector; and the whole is suspended by a curved wire, *f*, *f*, *f*, &c.

B. fig. 6, in the same drawing, represents a convenient form of a reflector for a carriage lamp, in which the centre of the illuminated space is at an angle of depression of about forty-five degrees from the lamp.

It will appear, from what has been before stated, that the principles hereinbefore laid down, both with regard to the construction of the lamps themselves, and with respect to the forms of the reflectors, are advantageously applicable in an infinite variety of cases; and we feel it right to say, that it is these principles, however applicable, that we conceive ourselves intitled to the sole and exclusive

application of, for the term mentioned in his Majesty's said Royal Letters-Patent, by force and virtue thereof, and which it is the object of his Majesty's said Royal Letters-Patent to secure and defend.

LXIII.—*On the Microscope. By the* EDITOR.

THE Microscope having always been a favourite instrument with the Editor; and being now, as it well deserves to be, in more universal request than ever; he believes it will prove acceptable to the readers of this work to publish a series of Papers on various useful improvements on that instrument, and the apparatus belonging to it, which have been invented by himself and others.

ON AN IMPROVED MICROSCOPIC CABINET, AND APPARATUS.

The Editor became possessed of this cabinet several years since; and having never met with any other like it, in the course of his long experience, he believes it must have been contrived by, and constructed for, its original possessor.

It is made of hard Jamaica mahogany, neatly framed together; and is only four inches high, four inches long, and three inches and seven-eighths wide, with neat mouldings around its top and bottom. The front is made to draw up; and exposes to view five drawers, the three uppermost being nearly half an inch deep, and the other two a little more than three-quarters. Each of the two top drawers contain thirty-six slender pieces of box-wood, one inch in length, one-eighth of an inch broad, and one-twelfth of an inch thick; painted on their upper surfaces with different colours: their intention is, to have small opake objects cemented upon them, and to be thus conveniently held in the plyers, so as to place the objects upon them in every possible situation for being viewed with the utmost facility and advantage. Some of these pieces are made a little broader in the middle; and others have also a small circular block

of wood, a quarter of an inch in diameter, and one-eighth of an inch in thickness, glued on the centre of each; a gap being made in the back of each block one-twelfth of an inch deep, to let the slip of wood into it: these blocks are also painted of different colours. The larger surfaces are for the purpose of receiving opake objects of a rather greater size than the others; and yet they are sufficiently small to be easily managed, like the others, in the plyers.

The advantage of these small and easily manageable slips, with their objects mounted upon them, in preference to the wooden sliders with round cavities made in them to hold the objects, now in common use, must be evident; and particularly in the abundance of light they suffer to pass by them, from the illuminating mirror below, to the silver concave speculum above, from whence it is reflected upon the objects: whereas, in the wooden sliders, the greater part of the light from the illuminating mirror must inevitably be cut off.

The small box-wood slips in each drawer are regularly numbered, from 1 to 36; and they are retained in their places in the drawers by means of four thin mahogany slips, each one-twelfth of an inch thick, being glued to the bottom of each drawer; the two outermost slips having twelve gaps made on their inner edges; and the two middle ones, a similar number on both sides. Into these gaps the ends of the box slips are received; and they are retained in their situations by two additional mahogany slips being glued above the outermost gaps, under which one end of each slip in the outer rows is placed; and by two loose mahogany bars, which fit into angular gaps made in the fronts and backs of the drawers to receive them; and the bottoms of which bars cover the ends of the middle row of slips, and also the other ends of the two outermost rows: and thus the whole are effectually secured from being displaced.

The third drawer in this cabinet holds forty-eight ivory sliders, with four cells in each, fitted up with talcs for

transparent objects, as usual; excepting, that the bottoms of the cells are made as thin as possible, so that the talcs are placed, as nearly as may be, even with the surface of the ivory, in order to enable the objects held within them to be viewed with highly magnifying powers. Each slider is also numbered on both its edges, near one end; so that let it lie with either edge upwards, the number of the slider is visible. These sliders are well suited to the usual description of microscopes; but, for single microscopes, having lenses of the fiftieth of an inch focus, (such as one made by the late Mr. S. Varley, in the Editor's possession,) they are totally useless. It will, however, be the study of the Editor hereafter to describe a method invented by himself, whereby objects can be mounted in such a manner as to be readily managed, even under such high magnifying powers.

The fourth drawer contains a number of thin glass tubes, of different diameters, from one-eighth to three-eighths of an inch, and three inches and a quarter long; both ends of them being fitted with corks, through which pass short capillary tubes of glass: the intent of which is, no doubt, to hold small living objects, so as to view them in the microscope with great convenience.

Lastly, the fifth drawer is fitted up with several useful contrivances; viz. two small glass cisterns, each being one inch in diameter, and half an inch in depth: these are made by cementing a flat circular plate of glass to a portion of a glass tube, ground truly flat on its edges:—also, another small cistern or trough, one inch and a half long, half an inch wide, and a little more than five-eighths of an inch deep. This cistern is made of a brass plate, grooved along each side, and its ends turned up at right-angles: into these grooves, slips of plate-glass are cemented; so that the sides only of this cistern are transparent; and small animals swimming in water contained therein may be viewed by the microscope, with a small magnifying power, to great advantage; as also in the two glass cylindrical cisterns before described.

This drawer likewise contains two slips of plate-glass, each two inches and five-eighths long, and five-eighths wide; and also two others of the same size: but the one is of a green, and the other of a purple colour, in order the better to view objects by a contrast of colour.

It also contains the usual supply of extra talcs in neat ivory boxes, spare brass rings, &c. And the Editor believes, that if such an ingenious combination of useful articles were now to be made, and exposed for sale in the opticians' shops, it would readily find purchasers.

ON AN IMPROVED SLIDER, FOR VIEWING ANIMALCULES IN WATER.

For the original idea of this useful contrivance, the Editor is indebted to Mr. Bottrell. He has however considerably lessened the difficulty of constructing it. It was, as originally made, formed of three slips of window-glass of equal size, cemented together with common glazier's putty. A semicircular piece was cut out of the side of one of the pieces, near its middle, with a glazier's diamond, previous to cementing the others on each side of it; and into the gap thus formed, water, containing the animalcules, being put, is retained therein by the capillary attraction of the two sides of the slider; and can thus be placed under the microscope, even in a horizontal position, and viewed with great convenience.

The Editor has, as above mentioned, lessened the trouble of making this useful slider, by substituting, in place of the middle glass slip, one made of card or paste-board, of the same shape; this must be coated on both sides, as well as on its edges, with any resinous or other cement which will resist water; and whilst the cement is in a melted state, must be applied between the two glass slips, previously heated, which it will thus cement firmly together.

It will be unnecessary to dwell at much length upon the great advantages of this slider; as it must be obvious that we can thus render water, and whatever animalcules &c. it

may contain, perfectly manageable under the microscope: and, besides, it gives to the upper surface of the fluid a perfect flatness, as well as to that of the lower one; neither of which can be obtained in the usual manner of placing water under the microscope in concave discs of glass, and thus making both its surfaces convex. Water, holding animalcules in it, can also be thus very conveniently placed in the solar microscope, and the animalcules viewed to great advantage.

[*To be continued.*]

LXIV.—*On a Factitious Silvering or Gilding, used in India.* By JOHN ROBISON, *Esq. F.R.S.E.**

THE Moochees and Nuqquashes of India, who are the makers and painters of a variety of objects whose purposes require ability to stand the effects of the weather, use an application, in ornamenting their work, which, in appearance, nearly equals gilding, and costs little more than common paint. It appears to me that this application might be useful, in some cases, in this country; particularly in chain-bridges, and other works where iron of a smooth surface is exposed to the atmosphere.—I use the freedom, therefore, of troubling you with what I recollect on the subject.

In preparing the factitious silvering or gilding in the small way, a quantity of pure tin is melted, and poured into a joint of bamboo, (perhaps a foot long, and two or three inches in diameter,) close at both ends, except the perforation at which the tin is poured in, which is instantly plugged up. The bamboo is then violently shaken, which, if well managed, soon makes the metal assume the form of a *very fine* grey powder: this being sifted, to separate any coarse particles, is mixed up in thin melted glue, and, if I recollect right, is levigated on a stone with a muller. The result is poured into dishes (commonly cocoa nut-shells) to settle, and the superfluous moisture poured off.

* From No. XII. of the Edinburgh Philosophical Journal, for April last.

When to be applied, it should be of the consistence of thin cream; and is laid on with a soft brush, like ordinary paint. When dry, it appears like a coat of common grey water-colour. This is gone over with an agate-burnisher, and then forms a surface of polished tin; a coating of white or coloured roghun (oil-varnish) being immediately laid over it, according as it may be intended to imitate silvering or gilding.

I have had tent-poles, travelling trunks, baskets covered with painted leather, and other articles, in constant wear and tear for years; in which, from its cheapness, this mode of ornamenting had been very liberally applied; and have often had occasion to remark the power which it appeared to have of resisting the effects of the weather.

On a first trial, some difficulty of manipulation may be found, in bringing the tin to a sufficiently impalpable powder, and also in hitting the proper quantity of glue to be put in. If the size be too strong, the agate has no effect; and if too weak, the tin crumbles off under the burnisher. A very little practice will make the process exceedingly easy.

We have extracted the above article from the Edinburgh Philosophical Journal, with a view of diffusing this useful process more extensively in this country; and also to point out the application of the *granulated tin* to the silvering and gilding of leather, in place of *leaf-silver*, and then varnishing it with a white or yellow lacker.

The granulating of tin or lead in this country is generally performed in a wooden box, made to shut closely, and previously rubbed over on its inside with chalk, to prevent the metals from adhering to the wood; and we apprehend, that, if the powdered tin be finely searced previously to mixing it with the size, there will be no occasion for the levigation mentioned by Mr. Robison.

We have repeatedly seen iron articles from India ornamented in the above manner, such as the hilts or handles

of sabres, the furniture of their sheaths, &c.; but had always supposed them to have been coated with tin, by dipping them into the fused metal, in the manner commonly practised in this country; and which, for articles small enough to be treated in this way, is a very useful process, on account of the close adhesion of the tin to the iron.

We very much doubt, however, the applicability of this Indian process to the purpose indicated by Mr. Robison, viz. the ornamenting and preserving the iron-work of chain-bridges, on account of the great expense, labour, and difficulty of burnishing large surfaces: but for works of a similar nature to those it is applied to in India, it is no doubt exceedingly well adapted, and may possibly lead to great improvements in ornamenting such works in this country.—See the following article.

LXV.—*On Gold-coloured Varnishes or Lackers; and on Dephlegmating Alcohol for Varnishes. By the late* William Lewis, *M.D. and F.R.S.* *

Silver, coated with a transparent gold-coloured varnish, is made to resemble gold so exactly, as wholly to supply the place of gold in some of the works called gilt. The basis of the varnish, or what gives adhesiveness and glossiness to the colouring matter, is a solution of lac made in spirit of wine.

Lac, or lacca, is a substance collected by certain insects in the East Indies: it is found incrustated on sticks or branches of trees, in brittle masses of a dark-red colour, which, being reduced into small grains, and freed from part of the colouring-matter by infusion in water, are sold under the name of seed-lac. It is in this state that the lac is to be used for varnishes: what is called shell-lac, or the

* From his *Commercium Philosophico-Technicum*, pp. 223 and 624. This valuable article throws additional light on the preceding one; and also furnishes the necessary Varnish for the factitious gilding, and other purposes.—Editor.

grains formed into plates by melting them in boiling water, does not answer so well.

The spirit must be highly rectified, or freed from any admixture of water; for otherwise it will not dissolve the lac. The most convenient and expeditious way of preparing the spirit for this intention, is, by adding some dry potash, or other fixed alkaline salt: the salt imbibes, and dissolves in, the watery part of the spirit, and forms therewith a distinct fluid at the bottom, from which the spirituous part on the top may be poured off. More or less of the salt will be required, according as the spirit is more or less phlegmatic: if the first quantity, after standing for some hours and occasionally shaking the vessel, wholly dissolves, more must be added, and the agitation renewed.

The spirit being thus dephlegmated, some seed-lac, reduced into fine powder, is added to it, in the proportion of about three ounces to a pint: the vessel being set in a moderate warmth for twenty-four hours and frequently shaken, a part of the lac dissolves; and the spirit, now tinged of a reddish brown colour, is strained off from the undissolved part, and set by for a day or two to settle. The digestion should be performed in a wide-mouthed vessel, covered so as to prevent the exhalation of the spirit. The undissolved lac softens into a viscous mass, so as scarcely to be got out through a narrow aperture.

In different portions of the foregoing solution, poured off clear after the straining and settling, some gamboge and anotta are dissolved separately. Gamboge is a yellow juice issuing from certain trees in the East Indies, and exsiccated into masses by the sun's heat. Anotta is artificially prepared from the red skins of the seeds of an American tree, by steeping and agitating the seeds with water till their colouring matter is transferred into the liquor: on boiling the strained liquor, the colouring matter is said to be thrown up to the surface, in form of scum, which is afterwards exsiccated by itself, and formed into masses; which, as brought to us, are moderately hard and dry, of a

brown colour on the outside, and a dull red within. Both these substances dissolve very readily in the spirit: the gamboge communicates a high yellow colour, and the anotta a deep reddish yellow. The solution of the gamboge is mixed with about half its quantity of that of the anotta, and a trial made of the mixture on some silver leaf: if the colour inclines too much to the yellow or the red, more of the one or the other liquor is added, till the true golden colour is obtained. There are sundry other materials, from a due mixture of which a like colour may be produced; as turmeric, saffron, dragon's-blood, &c.

The silver leaf being fixed on the subject, in the same manner as gold leaf, by the interposition of proper glutinous matters, the varnish is spread upon the piece with a brush or pencil. The first coat being dry, the piece is again and again washed over with the varnish, till the colour appears sufficiently deep.

What is called gilt leather, and many picture-frames, have no other than this counterfeit gilding. Washing them with a little rectified spirit of wine affords a proof of this; the spirit dissolving the varnish, and leaving the silver leaf of its own whiteness.

For plain frames, thick tin-foil may be used instead of silver. The tin leaf, fixed on the piece with glue, is to be burnished, then polished with emery and a fine linen cloth, and afterwards with putty applied in the same manner: being then lackered over with the varnish five or six times, it looks nearly like burnished gold.

The same varnish, made with a less proportion of the colouring materials, is applied also on works of brass; both for heightening the colour of the metal to a resemblance with that of gold, and for preserving it from being tarnished or corroded by the air.

The composition of a gold-coloured varnish, used by the English artists for brass and silver, was communicated to some of the French Academicians in 1720, by Mr. Scarlet, and in 1738, by Mr. Graham; and has been published in

the volume of the French Memoirs for 1761. Though I do not apprehend that this varnish is anyways superior to that above described, I shall here insert it for the satisfaction of the reader. "Take two ounces of gum-lac, two ounces of yellow amber, forty grains of dragon's-blood in tears, half-a-dram of saffron, and forty ounces of good spirit of wine: infuse and digest in the usual manner, and then strain through a linen cloth. The piece to be varnished must be heated before the liquid is applied: it receives from the varnish a gold colour, little different from that of the mercurial gilding, and may be cleaned, when sullied, with warm water." It may be presumed that the amber is of no great use in the composition; this concrete being very sparingly dissolved by the spirit.

As the spirit for varnishes ought to be freed from its phlegm or watery part, and as this is most conveniently effected by means of fixed alkaline salts, I accordingly directed the spirit to be shaken with so much alkali as should be sufficient to imbibe the phlegm. In Meyer's very ingenious German treatise on quicklime, published in 1764, it is observed, that spirit rectified with these salts is unfit for varnishes, particularly for such as are to be applied on gilt works; the spirit taking up a part of the salt, which darkens the colour, and prevents the speedy drying of the varnish. This observation seems to relate to spirits that have been dephlegmated, not simply by suffering them to stand some hours on the alkali in the cold and occasionally shaking the vessel, but by the application of a considerable heat; in which last case the spirit is known to take up a small portion of the alkaline salt. If, however, the spirit should in either way have received an alkaline impregnation, it may easily be purified by means of a little alum well dried and powdered; the alkali being absorbed by the acid of the alum, and forming therewith a compound not combinable with vinous spirits. Some persons, when a perfectly pure spirit is required, first dephlegmate it with alkaline salts, and afterwards purify it

from such part of the alkali as remains in it, by a fresh distillation from a quantity of alum: perhaps simple infusion, and agitation with the alum, would be as effectual, at least for the purpose of making varnishes, as the more troublesome process of distillation.

LXVI.—*Hints on Gardening. By the* Editor.

Improvement in Crown-grafting.

In grafting in the rind, or crown-grafting, the scion, as is well known, is inserted between the bark and the wood of the stock; the wood of the scion being in contact with that of the stock, and the bark of it with the bark of the stock; which is certainly the most natural method of grafting. It is not common, however, to take the following precaution, which very considerably promotes the success of the operation; viz. *to remove the outer bark of the scion,* previous to inserting it; *being careful,* at the same time, *not to wound the soft, inner, green bark.*

This mode was communicated to the Editor many years since, as being practised in Kent; but not having ever seen it published in any of the Works on Gardening, and being convinced, by experience, of the great utility of it, he thinks it highly desirable to make it better known.

The Editor grafted a variety of apple-stocks with scions of the Ribstone Pippin, putting only two into each stock, on opposite sides of it; being careful not to burst the bark, and also rounding a little the top of the stock: these all took, without even one exception, and in a little time grew over the top of the stocks, so as to render it difficult to perceive where they had been grafted; and one, in particular, produced a fine bunch of blossoms, the same spring it was grafted, notwithstanding it had been lying all winter buried half-way in earth; a clear proof of the excellence of the method.

IMPROVED MODE OF PIPING CARNATIONS, PINKS, &c.

This improvement consists in leaving the pipings, after carefully taking them from the parent plants, *one joint at least longer than usual*; cutting them, for instance, to three, four, or five joints, according to their strength; *and then making two cross-cuts from the bottom of the lowest joint to the joint above.* They must then be properly trimmed, and laid to dry for a few hours, to heal their wounds; after which, they should lie in water all night, and then be plunged to a proper depth in the soil, and covered close from the external air with a hand-glass or glass-bell, the rim of which should be thrust into the soil. The pot or box containing them should then be placed in a hot-bed of a moderate heat; and the soil should be kept moist, by pouring water around the outside of the glass: they should also be shaded from the sun, from ten o'clock in the morning till three o'clock in the afternoon, for the space of a week or nine days; after which time, they should gradually be inured to the open air; and, when any of them have taken root, they should be taken out, and planted in pots or borders, as usual.

The Editor is indebted for this improvement to the late Mr. Luke Pope, a well-known florist, then residing near Birmingham.

DARWIN ON PIPING SLIPS OR CUTTINGS OF PLANTS.

The following remarks on the process of *Piping* are extracted from the *Phytologia* of the late justly-celebrated Dr. Darwin, p. 150.

"The slips, or cuttings of plants, by being planted in the earth, become plants exactly similar to their parents. A small glass inverted over these *buds*, when set in the earth, contributes to insure their growth, by preventing too great an exhalation; otherwise they are liable to perspire more than they can absorb, before they have acquired

roots: this the gardeners call "piping a slip," or a cutting of a plant.

"In this situation, a greater heat may be given them, as in hot-houses, without increasing their quantity of perspiration, which ceases as soon as the glass is saturated with moisture; and the increase of heat contributes much to the protrusion of their roots and new buds, as they can at the same time bear to be supplied with a greater quantity of moisture."

SALISBURY'S IMPROVEMENT ON THE ABOVE PROCESS.

To this we shall also add a further improvement, made by Mr. William Salisbury of Brompton, in order to cause fresh shoots and roots to be *quickly* formed in some young apple-trees, which had lain for many months inclosed in a box closely packed up with the *sphagnum palustre* or *white bog-moss*, to prove its superior powers of preserving life in vegetables, to the satisfaction of the Society of Arts, &c. who had rewarded him for this valuable discovery, as applied by him to the importation and exportation of living vegetables.

He planted the trees in pots, covered them with bell-glasses, and *inserted the edges of the glasses into rims or borders of loam or clay, closely fitted also to the edges of the pots*; and thus still more effectually inclosed them from the entrance of the external air.

[*To be continued.*]

LXVII.—*On the Cultivation of the Water-Cress, for the London Markets. By Mr.* William Bradbery.*

Dear Sir,

I lately found that the *Water-Cress* is grown in this neighbourhood, by Mr. Bradbery, for the purpose of sup-

* From Vol. IV. of the London Horticultural Society's Transactions, communicated to the Secretary in a Letter from Henry Bellenden Ker, Esq. F.R.S. &c.

plying the London markets: and as I believe no account of the mode of culture has been yet published, I have made inquiries of Mr. Bradbery, who, with the greatest willingness, furnished me with the information which I now send to you.

Mr. Bradbery first began to cultivate the Water-Cress in February 1808, at Northfleet Spring Head, near Gravesend. For this purpose, he procured young plants, and placed them, with a small proportion of the wet earth in which they grew, in shallow running water: the plants soon formed large tufts, and rapidly spread over the water; and he gathered the cress regularly for the London markets.

Mr. Bradbery conceives that there are three sorts of this vegetable: the first he calls the *Green-leaved*; the second, the *Small Brown-leaved*; and the third, the *Large Brown-leaved*. The three sorts he considers to be the same in taste: although the large brown-leaved sort is, from its appearance, preferred in the market, and indeed I should suppose also from there being a lesser proportion of stalk to the leaf. They are varieties of the same species (*Nasturtium officinale**); but they are not noticed as such in the *Hortus Kewensis*, or in any other botanical work†: their difference does not appear to arise from the variation of quality or quantity of the water in which the plants are found, for the three may be seen growing together; though Mr. Bradbery states that some are more fitted than others for particular waters: the *Green-leaved* is easiest of cultivation, and the *Small Brown-leaved* is the hardiest. The *Large Brown-leaved* is the only sort he cultivates: it is the only one which can be well grown in situations where shallow water is not to be obtained.

It was soon perceived that the plants grew better, and

* Hortus Kewensis, Vol. IV. page 110.—*Sisymbrium Nasturtium*, Wildenow, Species Plantarum, Vol. III. page 489. — English Botany, plate 855.

† In Ray's Synopsis of British Plants, 3d Edition, page 301, a variety is mentioned, which blossoms earlier, and has smaller leaves.

had a superior flavour, when disposed in rows parallel with the course of the stream, than when left in irregular patches. When in rows, the plants are more regularly exposed to the influence of the current; and the water is not so much impeded in its course, because there are regular open channels between the rows. The cress is also more easily gathered from the rows, and more easily freed from weeds and the different matters which pass down the stream and become entangled with the plants.

Mr. Bradbery having left Northfleet last year, began to plant, at a considerable expense, beds of the cress, at West Hyde, near Rickmansworth. It was found necessary to vary the spaces between the rows, according to the depth of the water. When it is deep, the rows are, five, six, and even seven feet apart; whilst in shallow water, about eighteen inches' space between the rows is considered as sufficient. The plants are found to thrive best in shallow water; that is, when the depth is about an inch and a half; which increases when the plants begin to grow, and thereby check the current, to about three inches. In deep water, the roots are easily drawn out of the soil; which makes it difficult to gather the vegetable freed from the roots: if, therefore, a sufficient space covered with shallow water could be obtained, the deep water would not in any case be used.

The shoots are *cut* for market; not broken off, which is the usual mode of gathering the wild cress, and which latter practice is found to be very injurious to the plants in the beds. After frequent cutting, the heads are found to grow small.

The most expensive part of the cultivation is the necessity of clearing-out and re-planting the beds, twice a-year; as the mud quickly collects about the roots, and the duck-weed and other plants become intermixed with and choke up the cress: it is almost impossible to pick it in a fit state for market after the plantation has been made five or six months.

The mode of re-planting is, to remove all the rows of plants, beginning at the stream-head; and then to clear the bed of the stream from mud and rubbish, which, however, it should be remarked, make excellent garden-manure. From the mass of plants thus taken out, the youngest, and those with most roots, are selected: these are placed on the gravel, in rows, at the requisite distances, with a stone on each plant, to keep it in its place. The cress will not grow freely in a muddy bottom; nor will they taste well when there is mud about the roots, which should be carefully removed, and replaced by gravel or chalk. It is absolutely necessary to have a constant current; for when there is any obstruction to the stream or flow of water, the plants cease to thrive. The times of renewing the beds are in May or June, and from September to November. The planting is done in regular succession, so that the crops may come regularly into cutting. Those planted in November are ready to gather in the spring.

After the plants have been cut about three times, they begin to stock, and then the oftener they are cut the better: in summer, it is necessary to keep them very closely cut, and in water of a proper depth; and with a good soil, each bed supplies a gathering once a week. In winter, the water should be rather deeper than in summer (four or five inches): to obtain this, the plants are left with more head, that the water may be thus impeded. Mr. Bradbery has about five acres planted. He sends the cress in hampers, each containing eight dozen bunches, to the London markets, every day throughout the year, except Sundays; three days in each week to Covent-Garden market, and other three days to Newgate market.

The water in Mr. Bradbery's cress-plantations is produced from springs which rise in the swampy meadows bordering on the River Colne, and which have their sources not far distant from the spot he cultivates: it is essential that the plantations should be made in fresh or newly-risen spring-water; as the plants not only thrive the better in it,

but, in consequence of its being rarely frozen, they generally continue in vegetation, and in good state for gathering, throughout the whole winter season. The large space under cultivation at West Hyde has been gained by cutting away the banks of the streams, and thus widening the courses, which were originally narrow: in the beds of water thus artificially formed, a uniform depth is preserved, and the whole bottom is covered with clear gravel.

This cultivation of the water-cress has insured a constant and regular supply to the metropolis: and the gatherings are received much fresher, and more regularly packed, than those obtained from plants in the wild state; where little selection is made as to the quality, or attention paid to the state of the vegetable, which is usually sent up to town in sacks, and often much bruised and broken before it reaches the retail-dealer.

It should be added, that since the cultivated water-cress has been sent to market, the wholesale price is reduced one half. Mr. Bradbery is not aware that any one cultivated the water-cress prior to the time he first planted it at Northfleet.

I learn that there are two small establishments for the cultivation of the water-cress in the neighbourhood of Hackney, the produce of which is taken to Spitalfields' market: one of them, which is at Homerton, was formed about three years since; the other, which is at Hackney-Wick, has only lately been planted.

I am your very faithful servant,

HENRY BELLENDEN KER.

Rickmansworth, 14th Oct. 1821.

LXVIII.—*On Reducing Friction in Machinery. By the* EDITOR.

THE two chief sources of Friction, and consequent loss of power, in most Machines, are, the wear of the teeth of their wheel-work; occasioned by their improper shapes, and the rubbing of the pivots on their bearings.

It is of the greatest consequence to give such shapes to the acting faces of the teeth of wheels, pinions, racks, &c. as shall cause them to move upon each other with the utmost freedom. Among the writers of various Elementary Works, a great variety of discordant opinions prevail respecting the forms best fitted to produce this desirable result. The French, following their great mathematician, CAMUS, in his mistaken ideas upon this head, spoil the teeth of their wheel-work. And the great authority of the late Professor ROBISON has led to similar results, wherever his erroneous system has been adopted in this country. It is surely high time, therefore, that accurate ideas should prevail on this most important point; and that the powers of our various machines should no longer be wasted in destroying their wheel-work, instead of being usefully employed in performing the different purposes for which they are intended. And we believe that we shall render an essential service to this great manufacturing country, in endeavouring to set this question at rest, by describing the methods which, for many years, have been employed, with the utmost success and facility, by our principal mechanists; namely, Boulton and Watt, Bramah, Maudslay, &c.

Only two curves are proper for this purpose; viz. the *Cycloid* and the *Epicycloid*. The cycloid is generated by a tracing-point, fixed in the periphery of a circle, moving along a right line; or by a similar point fixed in a right line, moving upon a circle; and is proper for the teeth of wheels acting in racks, or, in other cases, where the one body moves in a circle, and the other in a right line. Professor Robison has erred, in applying the cycloid to the teeth of wheels and pinions, where both bodies move in circles, and where the epicycloid alone is proper. This latter curve is generated by a tracing-point fixed in the periphery of a circle moving upon another circle. Camus has adopted the epicycloid for the teeth of wheels and pinions; but, by some fatality, instead of generating it

simply, and, as is universally done by the best mechanists in this country, by the revolution of circles of the *primitive diameters* of the wheels and pinions upon each other, he is at the trouble of doing it by generating the curves of the teeth of his wheels between a circle of the *primitive diameter* of the wheel, and another of the *radius* of the pinion; and, *vice versa*, for his pinions: thus taking twice the pains he needed to have done—only to *spoil* his wheel-work.

Having pointed out these *capital mistakes*, we shall now proceed to give such practical instructions as will enable any competent person to construct the teeth of wheels, pinions, and racks, in the best and simplest manner; and such as the result of many years' experience in large mill-works have shewn to be most beneficial, during a long course of time in which the teeth of the wheels, &c. have worn without undergoing any change from the forms originally given to them,—a convincing proof that such forms alone were proper.

In the year 1803, shortly after witnessing these beneficial results, the Editor of this work gladly availed himself of the opportunity afforded him by the Editor of *Imison's Elements of Science and Art*, to publish an addition to what Imison had originally published on this subject in his work called *The School of Arts*; with an engraving, made by Mr. Lowry from the Editor's drawings. This Plate we have had accurately copied in outline for our present Number.

In Plate XIX. fig. 1. represents portions of a wheel and pinion; AB, being the *pitch-line* of the wheel, shewn by dotted lines, and CD, the *pitch-line* of the pinion. These pitch-lines are the *primitive diameters*, upon which the proportions and sizes of the wheel and pinion are calculated. Those parts of the teeth contained between the pitch-lines and the rims of the wheel and pinion, are to be made radii, or shaped to lines drawn from the divisions in the pitch-lines to the centres of the wheel and pinion. The curved parts above the pitch-lines, reaching to the ends of

the teeth, must be portions of epicycloids: in order to produce which, let two segments or portions of circles, equal to the radii of the pitch-lines, be drawn upon a smooth oaken or other plank, not less than half an inch in thickness, and let it be sawn or otherwise exactly shaped to those curves, see figs. 2 and 3; the first of which, being of the same curvature with the pitch-line of the pinion CD, and the second the same sweep as that of the wheel AB; a hole must then be bored obliquely in each, commencing a quarter of an inch from the edge on one side, and terminating in the edge of the opposite side; into each of which holes, a nail, &c. must be driven, until the points project a little below the holes, as at EE: these points must then be filed, so as to leave them exactly in the peripheries of the circles, just long enough to make an impression upon any plane surface placed beneath them; and must be rounded and made conical, so as to trace a smooth even line: then, after having rubbed the sides or circular edges of the segments with powdered resin, fix the segment (fig. 2) fast upon the pitch-line of the pinion; and apply the tracing-point in the other segment, fig. 3, successively to all the divisions of the teeth in the said pitch-line; and pressing its edge close to the edge of the fixed segment, cause it to roll or revolve about it, without slipping one way or the other, until it shall have described the curves proper for all the teeth of the pinion; then, taking off the small segment from the pinion, fasten the larger one upon the pitch-line of the wheel; and proceed to describe the curves of the teeth of the wheel, with the tracing-point in the small segment, exactly in the same manner as those of the pinion. The teeth in bevel geer should also be made partly radii and partly epicycloidal.

We shall next proceed to explain the method of applying the epicycloid to the lifting-cogs or cams of forge-hammers, and other similar purposes, where both the moving bodies describe arcs of circles. In this case, as only one tooth, cog, or cam, act at a time, we need only

form two segments of circles; one corresponding with the radius of the mill-shaft, or the place where the cog begins to act upon the hammer-tail, as C D, (fig. 4), and the other equal to the distance from the axis of the hammer to the aforesaid radius, as A B: then fixing the segment C D, in the manner before mentioned, upon a circle of the same radius, drawn upon any fit plane surface; we must furnish the other segment, A B, with a tracing-point, and proceed, as before, to describe the curves proper for the lifting-cogs: that part of the hammer-tail, upon which they act, requiring only to be made flat, and placed in a line drawn through both axes.

Fig. 5, represents portions of a rack and pinion; C D, the primitive diameter, or pitch-line of the pinion; and A B, the pitch-line of the rack: the sides of the teeth in the pinion, from the pitch-line to their bottoms, are made radii, as in fig. 1; but the sides of the teeth in the rack, below the pitch-line, are drawn at right-angles to the pitch-line: the curved parts of the teeth in the pinion, and rack likewise, are made *cycloidal*, by forming a circular segment corresponding with the radius of the pitch-line of the pinion, and a straight-edge or ruler, both being furnished with tracing-points in their edges: then fixing the circular segment fast upon the pitch-line of the pinion, proceed to describe all the curved parts of its teeth, by placing the tracing-point in the edge of the straight ruler, successively in all the divisions in the pitch-line of the pinion, and rolling it either one way or the other upon the circular segment, without slipping: then fixing the straight-edge fast upon the primitive or pitch-line of the rack, take off the circular segment from the pinion; and placing its tracing-point in the divisions made in the pitch-line of the teeth of the rack, roll it upon the straight-edge, either one way or the other, as before was directed, until all the curves of the rack teeth are also traced.

Fig. 6, represents portions of a stamper of a mill for bruising ore, pounding gunpowder, beating hemp, &c. and

of its shaft with lifting-cogs. A B, is a line corresponding with that part of the arm of the stamper upon which the lifting-cogs first act. C D, is the pitch-line of the axis, or the bottom of the curves of the lifting-cogs. In this case, we need not be at the trouble of making segments; but, describing a portion of a circle of the radius of the said pitch-line, upon any plane surface of wood, we drive a number of small nails, or tacks, into the said circular arc, leaving them standing half an inch above the surface of the wood; then fixing a thread to the endmost nail, we make a loop at its other extremity, in which we place a tracing-point, or pencil, E; and keeping the thread stretched tight, cause it to form tangents to the circular arc C D; and thus the tracer will describe a curved line, being a portion of a cycloid, upon the plane surface of wood, which curved line is the proper form for the lifting-cogs of the mill-shaft. The arm of the stamper should be made flat at the part where the lifting-cogs act upon it; and should be placed in a line pointing to the centre of the mill-shaft, at the time the cog first comes into contact with it.

To form a Templet, or Pattern-Tooth, to facilitate the application of the Cycloid and Epicycloid to the Teeth of Wheels, Pinions, &c.

As, however, it would in all cases be tedious, and in some nearly impracticable, to generate these lines and curves upon every tooth in a wheel, pinion, rack, &c.; we shall describe an easy mode of forming a templet, or pattern-tooth, and the manner of applying it with facility, not only to the large teeth of wheels and pinions in mill-work, but also to the teeth of the smaller wheels, &c. employed in cotton-works, clocks, watches, &c.

In order to which, having determined the radii of the pitch-lines, and made segments corresponding thereto; having likewise determined the height and the depth of the teeth, and divided the pitch-lines into teeth and spaces, as before; then, for wheels and pinions, instead of applying

the segments immediately upon the wheels or pinions themselves, we take a plate of brass, or other proper metal, *a*, *a*, (fig. 7); and fasten it (by means of pins, driven through holes made in its corners) upon any plane surface of wood: we then describe upon it, by means of compasses, or beam-compasses, the lines corresponding with the primitive diameter or pitch-line, and tops and bottoms of the teeth in the wheel or pinion; and fixing the correspondent segments fast upon its pitch-line, with the point fixed in the other segment, describe that portion of the epicycloid which reaches from the pitch-line to the tops of the teeth: then, after having taken off the fixed segments, draw a radius-line, from the commencement of the curve in the pitch-line, to the bottoms of the teeth; and taking the metal plate off from the plane surface, accurately file or shape one edge of it, from *b* to *b*, to those lines so drawn; and likewise shape its upper and lower edges to the circular-arcs described upon it; the extra portion from *c* to *c* may likewise be removed: then, taking a piece of wood (or, in case of small works, metal) of a proper thickness and breadth, and long enough to extend over at least two of the teeth, describe upon it a circular arc, *d*, *d*, exactly equal in radius to the tops of the teeth; and then slitting one end of it from *b* to *d*, fix into that slit the metal plate, before described, by that part of it which extends above the line *b*, *d*; observing, that it be so placed in the slit, as exactly to correspond with its situation when generated; that is to say, that the radius-line of the templet may point exactly to the centre of the circular arc *d*, *d*, of the piece of wood thus slit; and the similar arc *b*, *d*, of the templet, be in contact with that arc: it must then be fastened in that position, by drilling holes through both pieces, and rivetting them together, and thus leave a projecting shoulder on each side of the templet, as shewn by fig. 8: then, having turned the tops of the teeth to their proper diameter, we have only to apply the proper templet to each division in their primitive or pitch-lines; and resting at the

same time the shoulder of it upon the tops of the teeth, draw the exact form of each tooth, by two operations (changing the side of the templet alternately), upon each of its ends; and afterwards shape its sides accordingly.

In the case of racks, the same process will take place; excepting only, that a straight-edge or ruler must be fastened upon the primitive or pitch-line drawn upon the metal plate; when that portion of the cycloid must be generated (by means of a point, fixed in the circular segment corresponding with the pitch-line of the pinion which is to work in the rack), reaching from the pitch-line to the tops of the teeth: which done, the ruler must be taken off, and a line be drawn at right-angles from the pitch-line to the bottoms of the teeth: then, after shaping the edge of the metal plate to the said curve and right line, it must be fitted into a slit, made in a straight-edge or ruler of a proper thickness, to leave a shoulder on each side of it; so, as when applied upon the tops of the teeth in the rack, its primitive line may correspond with the primitive or pitch-line of the rack teeth; by which means, the shape of the teeth may be traced upon their ends (by two operations), in the same manner as the teeth of wheels and pinions.

[*To be continued.*]

LXIX.—*On the Preparation of various Fusible Metals, and on using them to most advantage. By the* Editor.

The usual composition for making a fusible metal, is as follows; viz.

Five parts of lead,
Three parts of tin, and
Eight parts of bismuth,
} melted together.

Another composition is given by Smith, in his work entitled *The Laboratory, or School of Arts*, under the head

saying, that he has brought this useful paper to its utmost perfection. The process for making it is as follows.

He employs that species of paper known by the name of Drawing-paper; such as is used by artists in water-colours, on account of its greater thickness than ordinary writing-paper, and its superior surface. This he prepares in the following manner. He rubs well into its surface, by means of a coil of list or woollen-cloth, or with a piece of coarse calico, the powder sold in the chemists' shops by the name of *prepared hartshorn* (being, in fact, the earth of calcined bones, duly levigated): after which, with another piece of cloth, he slightly wipes off any extra quantity of the powder; not however too closely, as the abrading effect upon the pencil depends on a proper quantity of the powder remaining.

METALLIC PENCILS.

In the preparation of these pencils, the Editor has likewise reason to congratulate himself in having adopted the *fusible metal* as the material they are made of. A small cylinder of this metal is held in a hole made in the centre of a hard-wood handle (as a pencil); with a metal-ring or ferule surrounding the hole, to prevent the wood from splitting, and a metal cap to it, as usual.

He melts the metal by putting a little of it into the angular gap made by folding a card double, and holding the card, at a proper distance, over the flame of a candle; moving it backwards and forwards till the metal is melted, which may be done without much injury to the card. He thus obtains a small angular slip of the metal; which he reduces, by filing, till it fits tightly into the hole in the handle; when it only requires to be pointed for use.

The composition is admirably adapted to this purpose; being sufficiently soft to afford a well-defined line in writing or drawing upon the velvet-paper, and yet hard enough to endure a very considerable time in use without requiring to be resharpened.

He has now twenty-four pocket common-place books, filled with memorandums made upon velvet-paper thus prepared. A sheet of drawing-paper, properly folded, forms a book of a very convenient size, consisting of upwards of fifty pages: it is stitched together, the edges cut, and carried in a morocco-leather cover, having a silver wire passed through the middle; each end of which turns over the central leaves, so as to retain the book in its place. The memorandums, thus made, may be considered even more permanent than written in ink; as every one's experience must have shewn, that ink is liable to fade in the course of a few years, and the writing to become entirely obliterated.

LXXIII.—*On an Improvement in using Asses'-Skin Tablets.*

This improvement consists in the adoption of a *pencil of fusible metal*, instead of the black-lead pencils in common use; and in cleaning the surface of the asses'-skin from all greasiness, by means of soap, applied in the following manner:—Dip the lump of soap (the common resin-soap is preferable, on account of its greater causticity, and its consequent greater action upon the asses'-skin) in water, and rub it lightly over the surface of the asses'-skin: then dip the fingers into water, and immediately apply the water and soap, by rubbing, to the whole surface of the asses'-skin: repeat this wetting and rubbing with the water, three or four times; and, lastly, wipe the surface of the asses'-skin dry with a linen-cloth.

After this treatment, the tablets will be found to receive the impressions of a silver style or pencil, or of an ordinary black-lead pencil, more perfectly than before; but especially that of the pencil of fusible metal: and with this great advantage, that the writing or drawings made by the latter are absolutely indelible by the ordinary means of washing with water; and yet can be removed, at pleasure, by the application of the soap in the manner above described.

LXXIV.—*On the French Varnish or Polish. By the* EDITOR.

THIS beautiful art has been applied to furniture, in this country, for a few years only: although it had constantly been used in some other branches of manufacture; as, for instance, in the polishing of musical instruments in the lathe, and otherwise.

The Editor was not a little surprised, on seeing a violin-bow-maker, many years since, previous to varnishing his work, moisten a piece of linen rag, which he was going to use, with olive-oil, previous to wetting it with the spirit-varnish; and still more so, at seeing the beautiful polish which it gave his work, on merely rubbing it with the oil and varnish thus applied.

The first publication on this useful art, in this country, appeared in the Repertory of Arts, &c. for July 1815, under the title of the *German Method of Polishing Wood*, by M. MARCEL DE SERRES; and was a translation from the *Annales des Arts et Manufactures*. But, whether owing to errors in the translation, or in the original from whence it was taken, it abounded in mistakes, both as to the method of applying the varnish, and also as to the temperature at which the solution of shell-lac in alcohol was to be made; which temperature, it stated, was to be at 50 degrees of Fahrenheit, or below the ordinary temperature of the atmosphere; being evidently a mistake, for 50 degrees of Reaumur, or about 124 degrees of Fahrenheit:—and it directs the varnish to be *mixed* with olive-oil, in the proportion of two parts of varnish to one of oil; and to be applied to the wood with a pallet of fine linen.

These mistakes prevented this publication from being of the least use in this country: and it was not until the year 1818, that the true method of applying the varnish was made known, by two Papers published by the Editor of this work in Thomson's Annals of Philosophy.

It was at that time employed by the late Mr. George Bullock (possibly with the assistance of French workmen),

for his rich articles of cabinet furniture; and was beginning to get into use among others. However, since the publication of the process, it has become, as indeed it ought, of universal application in the metropolis, among cabinet-makers, gun-makers, &c.

ON THE PREPARATION OF THE VARNISHES.

M. Marcel de Serres directs the varnish to be made of the purest transparent shell-lac, dissolved, in double its quantity of well-rectified spirits of wine, in a retort with a matrass, heated to about 124 degrees of Fahrenheit; shaking the mixture every three hours, until it is thick enough for use. It may be made thinner, by adding more alcohol; or thicker, by the addition of more shell-lac. This varnish contains no turpentine, or other body that might render it liable to crack.

He also says, that when the woods are wished to be kept of a light colour, gum-copal should be dissolved in alcohol, instead of the lac, adding to it a little camphor or ether; and that some of the Vienna varnish-makers dissolve the copal by exposing it to the action of the vapour of alcohol, and sometimes colour it with any tint they wish;—that when applied on large or extended surfaces, it should be thinned;—that when applied to the wood, it penetrates so completely into the grain, that it is almost impossible to crack it;—and that even when scratched by a sharp instrument, if the traces be not very deep, the polish may be restored by hard rubbing with a soft linen-cloth: whereas, the *viscid* varnishes have not this advantage; since they do not penetrate so deep into the substance of the wood, and a scratch will take them off in such a manner that no friction can restore the polish.

Another varnish, consisting chiefly of shell-lac, but made lighter-coloured by the admixture of other substances, is composed of the following ingredients; viz.

Shell-lac, three parts,	Gum-sandarach, one part,
Gum-mastich, one part,	Alcohol, forty parts.

The mastich and sandarach must first be dissolved in the alcohol, and then the shell-lac: and the process may either be performed by putting the ingredients into a bottle loosely corked, and placing it in a vessel of water heated below the boiling point of alcohol, till the solution is effected; or, by putting them into a clean Florence oil-flask, the neck of which is partially closed by a cork with a narrow slit cut along it, and heating it over a spirit-lamp.

The alcohol which may escape during the process (which, however, may be prevented, by making the solution in a retort and matrass, as directed in the first process) must be replaced by an equal weight of it, after the operation is over; as it is desirable that the varnish should consist of the accurate proportions given, in order to produce a proper effect. The solution may be poured off, for use, from any impurities which may remain; but it must not be filtered, as that operation would deprive the lac of some of its most valuable constituents.

Another varnish, which is coloured, for the purposes of deepening the tints of the articles it is to be applied to, such as gun-stocks, &c., is made as follows; viz.

Take gum-benzoin, one ounce; shell-lac, two ounces; and dissolve them in one pint of alcohol, as before directed.

Other gun-makers add *sanguis draconis*, or dragon's blood, to the shell-lac, with the same intention.

In cases where a greater degree of hardness in the varnish is desirable, and its colour is but a secondary object, a varnish composed of one part of shell-lac and eight of alcohol may be used.

ON THE PREPARATION OF THE WOOD, &c. FOR VARNISHING.

These varnishes may be applied to the surfaces of any of the harder woods, as also to those works which are composed of the hard-veined woods, or inlayed with them, or

with tortoise-shell, ivory, brass, silver, &c., such as the rich cabinet furniture, *Buhl* works, &c.

The wood must be prepared for varnishing, by taking out all the marks of the plane with a steel scraper, and bringing it to a smooth and even surface; and afterwards polishing it well with the finest glass-paper; as the varnish is laid on so thin, that it would expose every defect.

ON THE FORMATION OF THE RUBBER.

This must be formed of a long strip of thick woollen-cloth, such as drugget; to be *torn*, not *cut*, off the piece; as cutting would make the edge harsh, not soft, as when torn off: this strip must be rolled up in a flat coil, and tied fast with thread, wrapped around it: this may vary in size, from one to three inches in diameter, and from one to two inches in length, according to the greater or lesser extent of the surface to be varnished.

ON THE MANNER OF APPLYING THE VARNISH.

The varnish, put into a narrow-mouthed bottle, is to be applied to the middle of the flat face of the rubber, by laying the rubber upon the mouth of the bottle, and quickly shaking the varnish up once; as the rubber will thus imbibe just a sufficient quantity to varnish a considerable extent of surface. The rubber must then be inclosed in a soft linen-cloth, doubled; the remainder of the cloth being gathered together at the back of the rubber, to form a handle to hold it by; and the face of the linen-cloth must be moistened with a little raw linseed-oil (which may either be coloured with alkanet-root, or not), applied with the finger to the middle of it. The work to be varnished should be placed opposite to the light, in order that the effect of the polishing may be better seen; and a surface of from one to eight feet square may be varnished at once.

The rubber must be quickly and lightly rubbed upon the surface of the article to be varnished, and the rubbing continued until the varnish becomes nearly dry: the coil of woollen cloth must be then again wetted with the varnish,

but no more oil need be applied to the surface of the linen cloth, and the rubbing again continue till the varnish becomes nearly dry as before: and again, a third coat must be applied, in the same manner; then one with a little oil; which must be followed, as before, with two others without oil:—and thus proceed until the varnish has acquired some thickness, which will be after a few repetitions of the series; when a little alcohol may be applied to the inside of the linen-cloth, before wetting the coil with the varnish; and then rub very quickly, lightly, and uniformly, over every part of the varnished surface, which will tend to make it even, and very much conduce to its polish. The linen-cloth must next be wetted with a little alcohol and oil, without varnish; and the varnished surface being rubbed over, with the precautions last mentioned, until it is nearly dry, the effect of the operation will be seen: and, if it be found that it is not complete, the process must be continued, with the introduction of alcohol in its turn, as directed above, until the surface becomes uniformly smooth and beautifully polished.

It may perhaps seem to our readers, that the above process is tedious, and that it is described with an unnecessary degree of minuteness: such, on trial, however, will not be found to be the case, especially when it is compared with other modes of varnishing; as the effect is produced without the heat necessary in laying on spirit-varnish in the usual manner; and the polish is complete, without the trouble of laying on successive coats of oil-varnish with the brush, which must be allowed time to become dry between each coat, until it becomes sufficiently thick to bear being reduced to an even surface with the pumice-stone and water, and then to be polished with tripoli.

ON VARNISHING HOLLOW AND ROUND WORKS.

In this case, the woollen-cloth is not to be used with its flat end, *but on its side;* to which the varnish must be applied, as before directed, and be covered with two folds of the linen-cloth, oiled or not, as before mentioned.

ON VARNISHING RECESSES OR CARVED-WORK.

When this occurs in cabinet-work, &c., and where the surfaces are not liable to wear or are difficult to reach with the rubber, a spirit-varnish, made without lac, of the usual gum resins, and considerably thicker than that used in the above process, may be applied to those parts with a brush or hair-pencil, as is commonly done in other modes of varnishing.

ON VARNISHING WORKS IN THE LATHE.

This process is exceedingly easy; and does not require much more skill than the mere application of a little oil to the surface of a soft linen-cloth, and putting the lac-spirit-varnish upon it; then both together to be held upon the surface of the work, whilst turned round in the lathe, and rubbed along it, backwards and forwards, till the effect is produced.

LXXV.—*On Varnish-Making in general. By the* EDITOR.

FAUJAS DE ST. FONDE'S ELASTIC-VARNISH FOR SILK.

PUT one pound of glue into a new or very clean earthen pipkin; make it boil gently, till it ceases to crackle, or, which is the same thing, till a drop of it blazes on being thrown into the fire: then removing the pot from the fire, pour upon the glue (constantly stirring it all the while with a wooden spatula) one pound of spirit of turpentine. When united, boil this mixture for six minutes; and add gradually, continuing to stir it all the time, three pounds of boiling walnut, linseed, or poppy oil, previously rendered drying by litharge, or by exposure to the sun and air. Then boil the the whole for a quarter of an hour, and the varnish is made.

After it has stood about twenty-four hours, and a sediment is deposited, pour the clear varnish off into another vessel: and when used, it must be warmed, and applied to the strained taffety with a thick brush. One layer may suffice; but if two are to be applied, the silk must be stretched very tight, and the varnish applied in a

contrary direction to the former coat. The silk must remain distended, in the open air, until quite dry.

COPAL OR AMBER OIL VARNISHES.

Linseed, poppy, or walnut oils must be rendered drying, by exposure to the sun and air, on water placed in shallow leaden vessels, for three weeks or longer, until they are bleached white; and thus made fit for painting, or for the undermentioned purpose.

Copal or amber being put into a Florence-oil-flask, or other proper thin glass vessel or matrass, the vessel must be held by its neck (in wooden tongs, to avoid breaking it) over a clear fire (being careful, however, not to overheat or discolour the copal or amber), until they nearly cease to emit any white and acid vapours. The vessel is then to be placed in a heated sand-bath, where it must remain until it acquires the temperature of some of the above oil, which has been put into another similar vessel, and heated in the same sand-bath; when the oil is to be added to the copal or amber. Should the mixture be made before both the ingredients were of the same temperature, they would curdle, and not mix well. This mixture may be diluted, for use, by heating it, and some essence of turpentine, in separate vessels, to a similar degree, on a sand-bath, and then mixing them together; as, otherwise, a coagulum would be formed, and the copal or amber be precipitated in a solid mass.

For these judicious observations on making copal or amber-oil varnishes, the Editor is indebted to the late Mr. Richard Hand, formerly an eminent glass-painter at Pimlico.

[*To be continued.*]

LXXVI.—*On a Portable Press, for Copying Letters, taking Impressions from Plants, Printing in Lithography, Typography, &c. By the* EDITOR.

THE useful instrument, whose valuable properties we are about to communicate to our readers, is, simply, *the common*

Cylindrical Office-ruler, made of hard wood;—but the manner of employing it, is what constitutes the merit of its invention.

During the course of the last spring, the Editor commenced the improvement of a process which he had formerly employed for taking impressions from plants, and which will be presently described: for this purpose, he originally used Boulton and Watt's copying-press with cylindrical rollers, and afterwards Bramah's hydrostatic press. Desirous of substituting for these heavy and bulky machines, a light and portable instrument, fit for the botanist to take with him into the field, he was at last so fortunate, after a variety of contrivances, as to hit upon this truly valuable substitute.

This operation consists *in enabling a person to apply his whole weight to the ruler*; and thus to give a powerful pressure, in a single line only at a time, applied in succession over the whole surface to be impressed. In order to do this, all that is necessary, is, to place the paper, &c. upon a proper flat surface (a piece of smooth-planed wood, for instance, laid upon the floor of the room); then to lay the ruler across the paper, &c.; and upon the ruler to place another flat board, large enough to receive both feet of the person using it; who, mounting upon it, and resting his hands lightly upon the backs of two chairs, or any other proper support, in order to steady himself, must, by a little practice readily acquired, pass the ruler over the surface to be impressed,—in some cases only once, in others backwards and forwards, as required.

Having thus described the manner of employing this powerful agent generally, we shall proceed to give instances of its particular applications to the various useful purposes above enumerated. And first,

ON COPYING LETTERS.

In order to succeed in this operation, it is only necessary to add a little refined sugar to the common writing-

ink, which will cause it to give off an impression more readily from the writing made with it; and to use the machine-made silver or tissue paper, which costs only eightpence a quire. On the writing being dry, the sooner the copy is taken the better. In order to do this, the tissue-paper, previously cut to a proper size, must be wetted; which is very conveniently done, by laying it upon a common writing-slate or other dark-coloured flat surface, and applying all over it a wet sponge,(out of which most of the water has been previously squeezed by a moderate pressure), until no white spots remain upon the tissue-paper; which should then be laid between two pieces of blotting-paper, and lightly pressed, to absorb any extra quantity of water. Two thicknesses of writing-paper are next placed upon the lower flat board, a piece of the damped paper over these, and the writing upon the damped paper: two more thicknesses of writing-paper are then laid over the written paper, and upon that the ruler. The treading-board is now to be placed upon the ruler, and the impression to be taken in the manner before described.

A letter, written on three, or even four sides, may thus be copied at once; with the precaution only of laying between every two pieces of the wetted tissue-paper (between which is a leaf of the manuscript), a piece of writing-paper, rendered water-proof by coating it on both sides with boiled linseed oil, in the very same manner as is practised in using Boulton and Watt's copying-press.

ON TAKING IMPRESSIONS FROM PLANTS.

The methods of taking impressions from the leaves of plants, by smoking them, or by dabbing them with a ball covered with printer's ink, and then taking off the impressions upon damp paper, have long been known. But it will no doubt be allowed, that a facile mode of obtaining accurate impressions of the more delicate specimens, even in the field, will be no little acquisition to botanists, as well as to travellers in general; and to the ladies it will afford a most pleasing and never-failing source of amusement.

All the apparatus necessary to be taken into the field consists of a dabber, a book, and a cylindrical ruler.—We shall first describe the manner of making the dabber.

This should be made of a piece of fine kid-skin leather, with the smooth side outwards. A piece of round card, about an inch and a half in diameter, having its edge snipped all round with scissars into gaps, in order to permit the edge to turn up a little, is to be placed within the leather; a little loose wool being previously put on each side of it: the leather is then to be gathered together at the back, and secured by wrapping and tying a thread around it:—thus forming the dabber.

The book may be of any size, from 12mo. to folio; provided only that it is bound in a smooth leather cover, and is about an inch in thickness. It should contain a piece of smooth vellum, folded to hold a supply of printing-ink within its fold; which ink may be made of carbon or lamp-black, in a state of minute division, by merely holding an earthen-plate over the smoke of a torch (formed by inclosing resin in paper) until it is sufficiently blackened, and then sprinkling a few drops of olive-oil over it; mingling the oil uniformly with the lamp-black, by means of the dabber. The ink is then to be transferred, with the dabber, from the plate to the surface of the vellum, for use.

Having chosen the leaves or specimens of the plant from which the impression is to be taken, place them upon the blackened vellum, and apply the ink to both sides of the specimen, by gently striking the dabber uniformly thereon; changing the sides of the specimen from time to time, until they have received a sufficient quantity of ink: this is not so much as may be generally thought, as too great a quantity would merely produce a blot, and not that delicate impression of all the minute veins, ribs, and other projecting parts, which constitutes the chief beauty and merit of this peculiar method, and which requires the employment of the smooth kid leather and vellum to give off the ink to the specimens.

Having thus inked the specimens or leaves, the next thing is, to take impressions from them; two of which are made at once, in the following manner: A sheet of writing or drawing paper (equally damped by means of a wet sponge, as before directed, or in any other way) being folded, and the inked specimens placed and spread in the most natural manner between the folds, the paper is to be placed in the book, ten or more leaves from the cover, and the book laid on any level place on the ground: the ruler, or any other cylindrical body of a sufficient degree of strength to bear the pressure upon it without injury, being then placed upon the book, and the hands of the operator resting upon a gate or any other support nearest at hand, the impression may be made by standing upon the cylinder, and rolling it once only over the cover of the book; when it will be found that the impressions of both sides of the respective specimens will be accurately taken on the folds of the paper.

The Editor, for the sake of portability, has divested this apparatus of all the parts not absolutely necessary to be taken into the field: but where the process is to be performed at home, he would certainly recommend the use of the tread-board, to be placed upon the cylinder as before mentioned, and the supply of printing-ink to be taken from the plate, &c. on which the smoke was received. The specimens or leaves must still, however, be laid upon the vellum while inking them, for the reasons before given.

Ten minutes may be considered ample time for taking two impressions at once from a plant; and in this manner the Editor furnished himself, in the last year, with several hundred impressions, some of them of exceedingly great beauty and accuracy, and such as scarcely any botanist and very few artists would ever think of obtaining. He would, however, recommend the botanist to content himself with delineating the general features only of plants, whilst on his travels; and trust to the minute accuracy of the impressions which he should also thus make, for the proper

finishing of his drawings or engravings, when more at leisure.

The unlearned traveller may in this way very greatly contribute to the stores of the botanist, by thus taking impressions of such rare plants as he may meet with in foreign countries: and indeed a collection of impressions from Indian plants, exceedingly valuable, has been lately brought to this country.

We are also informed that, in Germany, botanical works have been illustrated by lithographic plates, made by coating the plants themselves with lithographic ink, and receiving the impressions thereof upon the stone; from which numerous copies have been printed, in the usual manner of lithography.

ON DRYING PLANTS FOR THE HORTUS-SICCUS.

It will be allowed, that a ready method of drying plants, by which they may be rendered fit for placing in the *Hortus Siccus* in two days, with their colours more perfectly preserved than when dried in the usual manner, must be a desideratum to botanists.

The usual process is, to place the plants between folds of blotting-paper, and to lay heavy weights upon them; frequently taking them out, to change the paper and prevent mouldiness, during the long space of fourteen days: this tedious process, no doubt, frequently prevents the botanist from making such large collections as he otherwise would be desirous of doing, owing to the great loss of time and trouble occasioned thereby.

If, however, we can by any means press out the juices of the plants, the complete drying of them consequently takes place in a very short time. To this end, therefore, the same apparatus, which we have described as applicable to the copying of letters, is equally adapted: all that is necessary, being, to lay the plant between several sheets of blotting-paper, which should be placed on the bottom board, with the other board above, and over it the ruler:

the pressure is then to be made, in the manner already described; which here may, as well as in other cases, be done by mounting upon the ruler itself; provided that the soles of the operator's shoes be thick enough to preserve his feet from injury, and that the ruler be sufficiently hard to sustain the action of the shoes upon it without damage; but, otherwise, a third board may be provided, to lay upon the ruler, for the operator to stand upon, as before described.

The juices of the plants will, by this means, be mostly squeezed out through their stems, and absorbed by the blotting-paper, at one operation. Should, however, the plants be very succulent, a repetition of the process may be found necessary. After this, a day or two will be quite sufficient to dry them completely for the *hortus-siccus*; the plants being again placed between blotting-papers, and moderately pressed, as usual, by weights laid upon them.

ON TAKING LITHOGRAPHIC IMPRESSIONS.

The Editor succeeded, on his first attempt, in taking a perfect impression from a stone containing six transferred manuscript-tickets for a Theatre, which had already afforded numerous impressions, in the following manner:— He placed the stone (which was properly inked and wetted, and had a sheet of damped printing-paper laid upon it exactly as in the case of printing in the Star Lithographic Press) upon the floor; and covered the printing-paper with a smooth calf's-skin leather, made of an equal thickness by machinery in the manner now commonly done for bookbinding: the smooth side of the leather was laid in contact with the printing-paper; and upon the leather was placed the ruler, surmounted by the tread-board: the impression was then given by mounting upon the tread-board, and passing the ruler two or three times backwards and forwards over the surface of the leather.

The lithographic printer, who afforded the means of making this experiment, declared that the impression, thus

Alumine was perfectly melted into a milk-white enamel.

Silex, into a colourless glass.

Barytes and strontian, into a greyish-white enamel.

Glucine and zircon were perfectly melted into a white enamel.

Lime, prepared by the calcination of Carrara marble, was melted into a perfectly white and brilliant enamel.—The splendour of the light was such, that the eye, when naked, and even when protected by deeply-coloured glasses, could not sustain it. The lime was seen to become rounded at the angles, and gradually to sink down; and in a few seconds there remained only a small globular mass.

Magnesia was affected almost exactly as lime: the light reflected was equally vivid; the surface was melted into small vitreous globules.

Platina was not only melted, but volatilized with strong ebullition.

A great number of minerals, such as rock-crystal, chalcedony, beryl, Peruvian emerald, peridot (chrysoberyl), spinel-ruby, &c., melted with the greatest facility.

In subsequent experiments which Mr. Silliman has communicated to us, platina, gold, silver, and many other metals, were not only rapidly vaporized, but entered, at the same time, into beautiful and vivid combustion.

Although the experiments of Mr. Silliman date in 1812, we have thought that they ought to be known upon our continent. They demonstrate, on the one hand, that Dr. Clarke has been anticipated in America, with respect to the fusion of bodies in the flame of hydrogen and oxygen; and on the other, that the blowpipe of Hare gives results almost perfectly identical with those of Brook.

REMARKS BY THE (AMERICAN) EDITOR.

Having, in company with Professor Griscom, used the blowpipe of Brook, and repeated with it many of the experiments cited above, we are constrained to agree with Messrs. Gay Lussac and Arago, (an authority which both

on this point and on that of *priority*, will probably be admitted as of the first import), and to say, that we can perceive very little, if any, superiority which Brook's instrument has over the *prior* and *original* invention of Mr. Hare. The *exact* apportionment of the gases is, at first view, a consideration of importance; but in practice, (and we speak from a long course of experience with Mr. Hare's instrument,) it is really found of very small moment. A little habit in using the instrument, soon enables the operator to decide by the eye, from the size and intensity of the flame, especially when directed upon any object, whether the proportions are right; and nothing is easier than to alter them, by simply turning the key of one stop-cock, or of the other, as may appear necessary. We can say, with the utmost confidence, that there is no difficulty on that head; and the results with the two instruments sufficiently establish this fact.

Theory would probably lead us to expect much from the effect of pressure:—but here again we were, when using Brook's instrument, greatly disappointed. We raised the pressure, by forcing in the mixed gases till the flat sides of the thick and strong copper parallelopiped, which is employed as a recipient, were swollen out till they were distinctly convex; and yet the intensity of the flame did not appear to surpass that produced by Mr. Hare's instrument, used with the aid of a pressure of a few inches of water.

Ought we, however, even from theory, to expect any advantage from pressure, beyond that which may cause the gases to flow decidedly to the focus, and with such rapidity as to keep up a constant supply. As there is nothing to confine the stream of gas—no re-acting force, particularly on the sides of the stream, except simply the pressure of the atmosphere, will not the effect of great pressure be, to dissipate, laterally, a portion of the gases so that they will not arrive at the focus; either burning out of it, or possibly, even to some extent, escaping combustion.

In Brook's instrument, also, were a high pressure deemed

of advantage, it is evidently very transient; as the moment the gases begin to flow, it is diminished, probably, in a geometrical ratio; and it is very soon reduced to a pressure not superior to that exerted in Mr. Hare's. From the small capacity of the reservoir, the entire duration of one charge of gas is also very short, and it is burnt out in a minute or two. It is true, it is possible in some measure to compensate for this defect, by employing an assistant to inject gas constantly while the flame is burning; but this, besides the inconvenience of the thing, would probably occasion vibrations in the flame.

The reservoir for Brook's blowpipe may, indeed, be made stronger and larger, to any extent; but who, considering the evident liability to explosion which, after all the ingenious contrivances to prevent it, does *occasionally* happen, would wish to be in the vicinity of even a cubic foot of these gases; which, when kindled, would of course exert, in their explosion, a force proportionate to the resistance of the walls of the reservoir, and might therefore propel fragments with even fatal velocity*.

* That this inference is not unfounded, will perhaps appear from the following fact. We had been accustomed (borrowing the experiment from the late Dr. Woodhouse of Philadelphia) to mix fulminating-mercury and oxymuriate (chlorate) of potash, by agitating them, on an open paper, by a feather; they were then gently poured into the bowl of a common tobacco-pipe; and exploded, by pouring sulphuric-acid upon them, out of a vessel held upon a long pole: the explosion was always very violent, but no harm happened from the fine fragments into which the bowl was always broken.

On one occasion, we substituted, for the pipe-bowl, a common tin-plate candle-extinguisher; placing it with the vertex, of course, downwards, in an iron candlestick, which was intended to act as a support. We were aware, that, by the explosion, the tin recipient would be torn; but we imagined that the fragments would hardly be projected; or, if they were, it was concluded that, on account of their thinness, they would not be propelled to any distance, nor with sufficient momentum to do any harm. But when the explosion occurred, the iron candlestick was split, although no part of it was missing; and the fragments of the tin extinguisher were shot out among the audience, to the distance of twenty feet all around; several persons were scratched; and one young man had the right temporal artery divided, so as to produce a copious hæmorrage. Perhaps this little incident will justify the remarks in the text.—AMERICAN EDITOR.

Especially would this danger be serious, were such volumes of the gases employed as to keep up a train of experiments four hours, without recruiting the gases. This is the case in the large pneumatic cistern in the laboratory of Yale College. The recipients for gas, in this, amount collectively to the capacity of fifty gallons: they are all connected at pleasure: the gas in them, when they are full, has a pressure of fifteen inches of water; and the consumption of half a cubic foot of gas reduces the pressure only one inch, and so in proportion.

This instrument, or one on similar principles, has been in use, in our hands, for the purposes of the compound blowpipe, seventeen or eighteen years; and no explosion ever occurred, or can occur, because the well of the cistern is between the two hostile gases.

The scale of the instrument has enabled us to indulge, even to luxury, in the numerous and splendid experiments of fusions and combustions, which were performed on most substances that possess any particular interest, in the successive public courses of chemistry, before the various classes, as well as in private researches, for years before the Cambridge experiments were ever heard of.

APPLICATION OF HARE'S BLOWPIPE TO THE SYNTHETICAL FORMATION OF WATER.

The synthetical formation of water, from the combustion of the oxygen and hydrogen gases, is of course an interesting experiment, to all who attend on a course of chemical demonstrations.

The apparatus of Lavoisier—or rather an enlarged and improved one which we had made, under our direction, in London—exhibits the fact extremely well; but the apparatus is expensive, rather complicated, and not without some practical difficulties in the use.

We have, this season, availed ourselves of Mr. Hare's blowpipe; and have applied it, with good success, to exhibit the formation of water. For this purpose, the two tubes which end in the frustrum of platina, are screwed out

and inserted through a cork: they are then again screwed into the platina; and are lastly connected with the tubes which lead to the reservoirs of gas, exactly as when we are to use the compound blowpipe.

An apothecary's bottle, which should be from fifteen to eighteen inches high, and of the capacity of about three or four gallons, is then filled with oxygen-gas. This is easily done, without the air-pump, by using a tube bent twice at right angles, and long enough to reach with one leg to the bottom of the bottle: the other leg is then screwed to the stop-cock of a large bell-glass: this last is filled with oxygen-gas, and, by being pressed into the well of the pneumatic cistern while the long leg of the bent tube is passed to the bottom of the large bottle, on turning the key of the stop-cock of the bell-glass the oxygen-gas flows in, lifts the common air out, and takes its place; thus filling the bottle with an atmosphere of oxygen-gas, without resorting to the air-pump, and without wetting the inside of the bottle, which would, of course, render the experiment nugatory, and the result ambiguous. It is known when the bottle is filled with oxygen-gas, by bringing a taper, that instant blown out, to the mouth of the bottle; when, if full, the taper will be re-lighted.

Things being thus arranged, the flame of the compound blowpipe is lighted, and is introduced into the bottle; taking care not to bring it within nine or ten inches of the bottom: the cork which is on the tubes, closes the mouth of the bottle*; which is, from the first moment, kept cold by copious streams of water, poured incessantly over the shoulders of the bottle; which if neglected for a minute or two, will grow hot, the vapour of the water formed will no longer condense, it remains in the form of steam, and, if the bottle be tight, will produce an explosion; or if, after the glass is once hot, we attempt to pour on water, the

* Not, however, *absolutely* tight, for fear of explosion, from the great rarefaction arising from the heat.

bottle cracks. But, by reasonable attention, there is no difficulty, and we let in both gases at once, or the hydrogen only, and the oxygen as it is wanted; and thus produce as much water as we choose, or as our gases will afford.

The experiment may be performed without first filling the bottle with oxygen gas, and by operating with it full of common air, but the nitrogen, in a degree, obstructs the combustion, and the result is less satisfactory.

This little application of Mr. Hare's blowpipe may, perhaps, be of some use to chemical demonstrations, and serves to evince the additional value of this fine instrument.

LXXVIII.—*On Various Cements.* *By the* EDITOR.

YATES'S WATER-PROOF GLUE OR CEMENT.

TAKE of the best Irish glue, four ounces; and of isinglass, two ounces: these must be dissolved in mild ale (*not stale*), over a slow fire, in a common glue-kettle, to the consistence of strong glue; when one ounce and a half of well-boiled linseed oil must be gradually added, and the whole well incorporated together by stirring. To increase the strength of the glue, more isinglass may be added.

This cement is applicable to the joints of wood, in every branch of manufacture; as also to joining earthenware, china, and glass;—care being taken to press the parts well together, and to allow them sufficient time to set.

The cement, when cold, and made into cakes, assumes the appearance of India-rubber; and, like it, is elastic. It may at any time, when wanted for use, be dissolved, by a gentle heat, in any proper iron or glazed earthen-vessel; first putting into it a little mild ale, to prevent it from burning at the bottom of the vessel; and adding more ale, to bring it to a proper consistence for use. To cement leather together, for harness, bands for machinery, &c., having prepared the joints in the usual way, as if for sewing, apply the cement while hot, laying a weight upon

each joint, as it is made: let them remain six hours before using, and the joints will then become nearly as firm as if made of one entire piece of leather. An excellent cement for stopping leaks in casks, &c. may be made by putting a little tow to the other ingredients. The Editor had this receipt from a Mr. H. YATES, in the year 1811.

GLUE AND RESIN CEMENT.

Two parts of glue and one part of resin are to be melted together; and a sufficient quantity of red-ochre added, to colour it.

This cement is used to cement hones into their wooden-frames, and appears likely to be useful for many other purposes. The Editor is indebted for it to the kindness of W. H. PEPYS, Esq., F.R.S., in the year 1802; from whom he had also the following.

GLUE AND LINSEED-OIL CEMENT.

Strong glue, well made with water, one pint; and one-eighth of a pint of linseed oil added to it, drop by drop, whilst boiling.

With this glue or cement, the joiners unite the parts of sign-boards, or other works which are to resist the effects of moisture.

The three preceding receipts afford curious instances of the possibility of uniting apparently discordant materials. Another instance of such a combination has been given at p. 358 of our present Number, in the composition of M. Faujas de St. Fonde's elastic varnish for silk.

ON THE GUM-AMMONIACAL CEMENT.

This cement is formed by adding to a solution of gum-ammoniac in proof-spirit, some isinglass or parchment-glue, and uniting them in a gentle heat.

The chief value of this cement consists in the great readiness with which it melts in a small degree of heat, and the little tendency it has to be affected by mixture.

This cement is very much employed by entomologists, in joining together the dislocated parts of insects; for which purpose it is exceedingly convenient.

ISINGLASS CEMENT.

Isinglass, dissolved in brandy or proof-spirit, readily melts by a gentle heat, and forms a very useful and convenient cement.

SALISBURY GLUE CEMENT.

This is made by dissolving the Salisbury glue (which is much stronger and lighter-coloured than the common English or Irish glue) in gin or proof-spirit; and is a very convenient cement, similar to the above, but harder.

CEMENT OF ISINGLASS AND GUM-ARABIC.

This cement is composed of two parts of isinglass, and one part of the best gum-arabic, put into a bottle, and covered with gin or proof-spirit; and the bottle being loosely corked, is to be placed in a vessel of water, and boiled till the solution is effected; which may then be strained for use.

In this valuable cement, the isinglass and gum-arabic correct each other's defects; the isinglass giving to the gum toughness, and the gum increasing the hardness of the isinglass; and both together forming a most useful cement, particularly for mounting opaque objects for the microscope.—The Editor is indebted for it to Mr. RATLEY, of Duke's-Court, St. Martin's-Lane.

[*To be continued.*]

LXXIX.—*On an Improved Mode of taking Casts from the Head. By Mr.* JAMES DEVILLE.

THERE has hitherto existed a great difficulty in moulding the entire human-head in plaster of Paris. Mr. Deville has completely succeeded in removing this difficulty, by the invention of a copper receptacle, filled with the prepared plaster; which receives and moulds the hinder parts of the head and neck, whilst the moulding of the

face and other parts are going on. The copper receptacle has a rim or border, extending nearly around it, for the plaster to rest upon. Mr. Deville has likewise invented a most convenient and portable couch, whereon the person undergoing the operation may rest nearly in a recumbent posture. He has also reduced the process to such perfection, that the time requisite for the whole operation does not ordinarily exceed ten minutes: and has besides introduced such facilities and conveniences, the result of his long experience and practice in general moulding, that the operation is entirely freed from those unpleasant circumstances which have hitherto contributed to prevent this truly useful art from being so generally employed as it ought to be.

It must be obvious, that, next to a bust, a cast, thus taken, (and especially after the eyes have been opened, and the mouth a little altered, which entirely removes the unpleasant appearance of these casts,) is the most faithful representation of the human features, and, indeed, is essentially necessary to the proper execution of a bust.

Mr. Deville is now continually employed in making casts from the life; and has lately been honoured by several Ladies submitting to the operation.

The study of *Phrenology*, now so fashionable a pursuit, has received great assistance from the numerous casts already made by Mr. Deville; and, whatever may be the final result in regard to the positions maintained by its professors, the accession of so many accurate resemblances of eminent persons must inevitably contribute to the advantage of the public.

Mr. Deville has already a very large and highly-interesting collection of these casts, at his manufactory and extensive gallery in the Strand, exhibiting gratis, for the gratification of the public, and of those persons in particular who are now pursuing the study of Phrenology.

LXXX.—*On Iron and Steel. By the* EDITOR.

ON THE PARTIAL CONVERSION OF IRON INTO STEEL.

[Continued from p. 260.]

THE benefits to be derived from the partial conversion of iron into steel are still farther exemplified in the instance of using blistered steel; which, as is well known, is in thick bars, but partially converted in the middle; at any rate, it more nearly resembles iron in that part than steel. This property, however, in the hands of skilful workmen, is no disadvantage, but the contrary. Mr. H. Maudslay has long been in the habit of availing himself of this, in steeling edge-tools, &c. in the following ingenious manner:—He splits the bar into two parts, down its middle; and again, for some purposes, subdivides those split parts: he then welds the internal part, or that which most nearly approaches to the state of iron, to the iron of which the tool is made, and thus preserves the external coat of steel to form the edge of the tool he is making.

ON WELDING CAST-STEEL TO IRON.

This is a very difficult process, and not to be done but by skilful and careful workmen, on account of the cast-steel becoming so fragile when highly heated. The art, however, is this; namely, to heat the iron to the highest degree it will admit of, and the steel as hot as it will safely allow; and, laying them together, the extra heat of the iron will cause them to unite, by hammering: excellent hammer-faces are steeled by this method, which prove very durable in use. Dies for stamping medals, coins, &c. are made in a way somewhat different:—A cylinder of cast-steel is inclosed in a hollow ring or cylinder of iron, which guards it in the fire from being too highly heated; and, when carefully welded, the outer surface of the steel is cut away, and an excellent die is thus formed. These dies are hardened, after being properly heated, by placing

them under a stream from a column of water of considerable height, and carefully removing or brushing off the air-bubbles (which form whilst they are cooling) with a birch-broom.

ON CASE-HARDENING IRON.

This is effected by inclosing the articles in carbonaceous compounds, either animal or vegetable, and exposing them to heat, in close vessels, until the change is completed, and the surface, at least, of the articles is converted into steel. For this purpose, bones, from which the ammonia has been extracted by distillation in close vessels at a high temperature, and which are afterwards ground to a coarse black powder, are chiefly used: the articles, being surrounded with this powder, contained in cast- or sheet-iron vessels, are exposed to a high red heat, in an open fire-place, for several hours, until the surfaces of the iron articles are sufficiently changed to steel; when, if large enough, they may be taken out, whilst hot, and quenched in water; or, if too small and numerous, the whole contents of the vessel, bone-dust and all, may be poured into the water. Any parts of the articles which are required to remain *iron* after this operation, may be guarded from the action of the carbon, by coating them with clay or loam.

Sometimes the water is covered with a layer of oil, two or three inches in depth, to prevent the small steel articles from being cracked in quenching: and it is very convenient, in this case, to have a wire-sieve suspended in the water, at a proper depth beneath its surface, to suffer the bone-ashes to fall through, but to catch and detain the small articles, and bring them with it out of the liquid.

Other substances are also employed for case-hardening; particularly leather, burnt till it will pulverise, which is a very powerful agent; also the hoofs and horns of animals, after being dried in an oven, and beat to a coarse powder, which are preferred by gunsmiths for their work.

ON DECARBONATING CAST-STEEL.

This process is much used, where it is wished to form steel articles free from flaws or other blemishes, which more or less abound in all kinds of iron; and which might considerably lessen their value, after bestowing much time and expense in forming them: whereas cast-steel, treated in the manner now to be described, forms the softest and purest iron, fit for the most delicate purposes.

The cast-steel, in slender rods, plates, or sheets, is coiled up spirally, leaving sufficient spaces between the coils; and is put into iron-cases, filled either with rusty iron-filings, or scales from the smith's forge, so as to be in contact with the steel everywhere: these cases are then placed in an open fire-place, and continued in a red heat for several days and nights, according to the thickness of the steel, and until, on trial, it entirely loses its property of hardening when quenched in water. The carbon has, in this operation, quitted the steel, to unite itself with the iron-filings, &c.; and the steel is now become pure iron, very easily worked into any required shape: and it is either left in its soft state, for some purposes; or it may be partially converted into steel, by case-hardening, to receive the most exquisite polish, when necessary.

ON FORMING IRON-FILINGS AND SCRAPS INTO BARS.

This operation is termed *balling;* and is effected by wetting the filings with a solution of common salt in water, and spreading the mass upon pieces of coarse cloth: the scraps of iron are next placed upon it, and enclosed by wrapping the filings and cloth around them: they are then tied up securely; and laid by, until the action of the muriatic-acid upon the filings has corroded and hardened them into a hard mass; when the cloths are taken off, to serve again; and the ball of iron is put into the forge fire, heated to a welding heat, and drawn out by hammering into bars for use.

ON MAKING VERY TOUGH IRON.

This is effected by selecting those parts of articles which consist of iron and steel welded together; such as, the shoulders of old bayonets and sword-blades, of table knives, &c.; the steel parts being previously cut off to serve again as steel. These shoulders are then to be put into earthen vessels, termed Balling Pots, and heated in a proper reverberatory furnace, termed a Balling Furnace, to a welding heat, and submitted to the action of a forge-hammer; which soon causes the earthen crust to fall away from the mass, and, by proper management, converts the mixture into bars for use, as an extraordinary tough iron, equal to the old-sable Russian iron; owing, no doubt, to the mixture of steel with it.

[*To be continued.*]

LXXXI.—*Account of the Copperas Mines, and Manufactory, in Strafford, Vermont. By Dr.* JOHN LOCKE.*

THE Mine is situate about twelve miles from Dartmouth College, and about five miles from Thetford. It is near the summit of a hill, which rises probably two or three hundred feet above the bed of the streams in the valley below.

The gangue in which it occurs is mica-slate; the strata of which are very highly inclined to the horizon, and present their long ridges above the surface, in various parts of the hill, particularly at its summit. There are occasionally veins of quartz in the slate. The rocks for several miles around are, as far as I observed, principally mica slate.

There are no particular indications of iron at any considerable distance from the mass of the mine, but the transition from the slate to the pyritic ore is abrupt. The mine has been opened obliquely up the hill, about seventy rods in length and four in breadth. The ore has been traced near half a mile, running pretty much in the direction of the strata.

* From Vol. III. of SILLIMAN's American Journal of Science and Arts.

The ore consists of an aggregate of quartz and undecomposed pyrites in small grains. In its granular aggregation, the ore resembles the quartz and feldspar in fine-grained granite. The pyrites constitutes the greater proportion. Many specimens contain abundance of needle-shaped crystals of schorl. Its fracture possesses metallic lustre; and most of it approaches in colour to pale brass, from which it varies to steel grey.

The ore is very compact, and is obtained for manufacturing by drilling and blowing. In manufacturing it into copperas, it goes through the several operations of decomposition, lixiviation, and evaporation; each of which constitutes a distinct operation. For several years, the manufacturers effected the decomposition in the following manner: the ore was broken into fragments of a foot or less in diameter, and heaped upon inclined scaffolds erected and floored with plank for the purpose. Thus exposed to the action of air and moisture, it very gradually decomposes at the surface. Thus, from the same mass of ore a solution was obtained year after year, either by the rains, or by the application of water by other means. The solution was received, from the inclined scaffolds, in plank cisterns.

For three or four years past they have adopted a more expeditious method of decomposition, which was discovered in the first place by accident. They break the ore into much smaller fragments, three inches and less in diameter; and throw them into a convenient heap, taking care to leave air-holes at the base, so as to allow the air to pass freely through the heap. On applying water, the decomposition commences; and so much heat is evolved, as presently to raise the temperature of the heap to such a degree as to charr wood, boil water, sublime sulphur, &c. Great quantities of sulphurous acid gas are evolved during the process; and in the course of three or four weeks the whole becomes de-integrated, and ready to fall into the state of powder. It then, by lixiviation with water, yields all its

wash of the whole mine. There has been cut in the compact ore, quite across the lower edge of the mine, a channel, into which, by its inclination, the mine discharges the wash of every shower, together with the natural oozing from the hill above. A trough conveys the fluid from the channel to the boilers. To increase the effect of this natural brook of copperas, the ore has been broken into large fragments, and heaped along the upper side of the channel, there to undergo a slow decomposition, precisely as it does upon the scaffolds mentioned above.

The mine where it has not been opened, is covered with oxide of iron, which consists principally of incrustations of vegetables.

In the part where I examined these incrustations, they are about three feet deep. The vegetables seem to have been enveloped by a thin uniform crust; but having decayed and disappeared, the crust remains an empty mould or pattern of the vegetable. The general figure of the vegetable is pretty well preserved in the external form of incrustation; but the internal cavity is wonderfully perfect, the sinuosities of the bark, the veins of the leaves, and the striæ of the buds, being preserved to microscopic minuteness. The impressions are so perfect, that it is difficult for one to convince himself that the real vegetable is not there. All the vegetables that we should expect to find upon a given spot of ground in the woods, seem to occur there. I could in general recognise the species, and even the varieties. Among the specimens I obtained, were the following: branches of the hemlock-fir and its cones; nuts, burrs, and leaves of the beech; hazel-nuts; and a species of golden-rod, which I recognised by a peculiar swelling often produced upon this plant by an insect. I could not ascertain that any animals had ever been found incrusted. The incrustations are divided into several strata, by layers of oxide; which have a structure so compact as to present a fracture, almost or quite vitreous.

The superintendant told me, that four men manufactured one hundred tons of copperas in a year, besides carrying on the business of a small farm.

A small quantity of the ore has been found, which had undergone a spontaneous decomposition, and was thought to be very rich. The superintendant told me, that a barrel of it afforded three hundred and thirty-three pounds of copperas. When I considered the quantity of iron the liquor dissolves, and the water it acquires in crystallization, this statement seemed less incredible than at first.

I have deposited specimens of the gangue, of the ore in its various conditions, the crystals, &c., in the New England Museum, Boston.

JOHN LOCKE.

LXXXII.—*On the Tests for Arsenic. By Professor* SILLIMAN.*

IT is a question very interesting to Medical jurisprudence, whether there is any test for arsenic, which can be implicitly relied on, to such an extent as to justify, on that ground alone, the condemnation of an accused person. Some experience in such cases has produced in us an increasing impression, that nothing short of the actual production of the metallic arsenic can be safely relied on for the above purpose; although various tests may serve, more or less perfectly, to guide the inquiries, and to influence the opinion of the practical chemist.

A pupil, Dr. T. D. Porter, now a member of the faculty of the University of South Carolina, in his inaugural dissertation, states, that he finds, on repeating some of the popular experiments, with onion-juice, which were some time since published in the newspapers;—that the onion-juice, with the solution of sulphate of copper (blue vitriol), but *without* the carbonate of potash, produces, in a weak arsenical solution, "a shade like Scheele's green;" but, if

* From Vol. III. of the American Journal of Science and Arts.

carbonate of potash be added, the effect is completely different. Considering Scheele's green as a test that has been much relied on for the discovery of arsenic, Dr. Porter formed it in the usual way, with sulphate of copper and subcarbonate of potash: in one experiment, a decided precipitate was produced from a *stronger*, and, in another, a scarcely perceptible one from a *weaker* arsenical solution. Coffee was then added to the solution of copper and of carbonate of potash, but *without arsenic;* and the effect resembled that of the stronger arsenical solution, more than this last was resembled by that of the weaker.

But the most important facts mentioned by Dr. Porter remain still to be stated. He found, that in the production of Scheele's green, by arsenic, sulphate of copper, and carbonate of potash, *chromate of potash* might be substituted for the arsenic; and that it produced a precipitate not to be distinguished, by the eye, from Scheele's green. He ascertained, also, that even Mr. Hume's celebrated test, nitrate of silver (as modified in its application by Dr. Marcet), gave, with chromate of potash, a yellow precipitate; which, when placed side by side with one produced by arsenic, could not be distinguished by their colour and appearance. Dr. Porter's experiments appear, then, to throw still greater suspicion on the infallibility of tests for arsenic, and, are worthy of being repeated*. His results were exhibited to us.

* The nitrate of silver used by Dr. Porter, was the lunar caustic dissolved; and the chromate of potash contained an excess of alkali, having been formed by heating potash on chromate of iron.

LXXXIII.—*On the Discovery of Chromate of Iron in Shetland.* *By* SAMUEL HIBBERT, M. D.*

5, Hill Place, Edinburgh, February 7, 1820.

SIR,

I HAVE the honour to make a communication to the Society of Arts, &c. &c., respecting the discovery which I originally made two years and a half ago, of the Chromate of Iron in the Shetland Islands; which substance is at present obtained for the manufacturers of colours, at a considerable expense, from the United States of America. Since a notice first appeared in the journals relating to the discovery, considerable inquiries have been made concerning it; but, that I might not create expectations which could not be realised, I was unwilling to make further communications on the subject until I had made a second visit to Shetland, when I ascertained that it exists there in great abundance. Conceiving, therefore, that the patriotic Institution of London for the Promotion of the Arts and Commerce of Great Britain was the most suitable medium through which the knowledge of the place and circumstances, under which the chromate of iron is found, might be first communicated to those who are commercially interested in the discovery, I have taken the liberty of transmitting to you a set of specimens,† which, in reference to the annexed description, will illustrate the varied character of the mineral. If my discovery shall be considered as a contribution to the commercial resources of the British Islands, it will afford me some recompence for the considerable time and labour which I have expended in the prosecution of the search after this important ore.

I am, Sir, &c. &c. &c.

A. Aikin, Esq.
Secretary, &c. &c.

SAMUEL HIBBERT, M. D.

* From Vol. XXXVIII. of the Transactions of the Society of Arts, &c. &c. In a Letter to the Secretary.—The Society voted their Isis Gold Medal to Dr. Hibbert, for this important discovery.

† Which are now in the repository of the Society.

CIRCUMSTANCES UNDER WHICH THE CHROMATE OF IRON IS FOUND IN SHETLAND.

The Chromate of Iron occurs in the serpentine rocks in the neighbourhood of Balta Sound, in the Island of Unst. I was first led to a search after this ore, by observing innumerable fragments of it strewed about the hill in which it is found, and even contributing to strengthen the fences of the country. It is observed, in the form of imbedded and insulated masses, at Buness, close to the house of the proprietor, Thomas Edmonstone, esq. The extent of the greatest mass is not, however, ascertained; as it is on one side concealed by the sea, and on the other by the deep soil of a meadow. It was traced three feet in breadth, and fifteen feet in length. At Hagdale, near Haroldwick, the chromate of iron occurs in the form of numerous thin ramifying veins; but these are only from two to three inches in breadth, sometimes increasing to the breadth of five or six inches. Many masses are elsewhere observable, extending a few feet, and then losing themselves in a general dissemination throughout the serpentine rock in which they occur. This dissemination consists in the diffusion of granular particles, of the colour and size of gunpowder.

It is evident, from this description, that the most promising appearance of the ore is adjoining the house of Mr. Edmonstone; and from this gentleman, whom I have made acquainted with all the circumstances of the mineral, any commercial inquiry will meet with the most satisfactory answer. Letters may be directed, "Thomas Edmonstone, Esq.; of Buness, Island of Unst, Shetland."

Upon the encouragement, however, from London will depend the renewed searches after the chromate of iron; not only on Mr. Edmonstone's grounds, but in the adjoining hills, which are the joint property of several landed proprietors in Unst. From the quantity, therefore, of the ore which has been found in detached portions on the hills, and from the promising appearance on Mr. Edmonstone's

grounds, I would submit to the manufacturing chemists in London the propriety of rendering to the Shetland Gentlemen every scientific assistance which they may require from their advice, or even, if wanted, from other exertions in prosecuting the search after this ore, provided its quality suits their purpose. It appears to me that some serious obstacles cannot fail to result from the inexperience of the Shetland Gentlemen, in whatever concerns the operations of mining.

Vessels trading from Leith to Shetland visit Balta Sound almost every month, in the course of the spring and summer.

In furnishing the foregoing particulars relating to the chromate of iron, I have only to add, that I shall be happy to answer any personal inquiries on the subject, concerning whatever I may have left unexplained.

SAMUEL HIBBERT, M. D.

Portions of the specimens of chromate of iron transmitted by Dr. Hibbert were put into the hands of several members of the Society for examination, with respect both to the quality and richness of the ore as compared with that imported from the United States. Samples of chromate of lead prepared from the American and Shetland varieties of chromate of iron were laid before the Committee by Mr. Midgley, one of the Chairmen of the Committee of Chemistry, who has had large experience in this branch of chemical manufacture. The result of this gentleman's investigation (confirmed by the experiments made by other members of the Society) is, *that the ore from Shetland, in quality, is quite equal to that imported from America; and in richness, as far as can be judged from a few specimens, is superior.*

LXXXIV.—*On an Improvement in the manner of collecting British Opium. By* JOHN YOUNG, *Esq., Surgeon.*

SIR, *Edinburgh, March 15th*, 1820.

SINCE I had the honour to correspond with you on the subject of my communication to your Society respecting my mode of collecting British Opium, and for which I had the honour to receive the Gold Isis Medal, I was last summer engaged in the same experiment, on a larger scale than formerly; and I produced nineteen pounds and a half of opium, twenty-five gallons of poppy oil, and at the rate of 40 bolls of early potatoes, from 129 falls, 18 square yards, (being 30 falls less than one acre of ground,) by the mode of cultivating communicated to your Society, and afterwards more particularly detailed in the 2d and 3d Nos. of the Edinburgh Philosophical Journal; with this difference, that after scarifying the heads, *the gatherers collected the milky juice with their thumbs instead of brushes, scraping it off their thumbs on the edge of the tin flasks; which I consider to be a material improvement in the mode of gathering:* and although I had from twelve to twenty boys, from 12 to 14 years of age, employed during the season, only two were affected with drowsiness; and I could not be certain whether this was the effect of the absorption of the opium, or of the extreme heat of the weather. By this new mode of gathering the milky fluid of the poppy, one of the boys, more than once during the season of gathering, filled his flask in one day of ten hours' work; the flask contained 14 oz. which, when evaporated, gave *three ounces and two drachms of solid opium.* I may observe, that owing to the extreme heat and want of rain during the last opium harvest, my plants came so rapidly to maturity, that I did not get so much opium as I probably should have done had there been occasional showers.

I am Sir, &c. &c. &c.

A. Aikin, Esq. Secretary, &c. JOHN YOUNG, *Surgeon.*

* From Vol. XXXVIII. of the Transactions of the Society of Arts, &c. &c. in a Letter to the Secretary.

LXXXV.— *Thoughts on the Pathology and Treatment of Cynanche Trachealis, or Croup.* By N. CHAPMAN, M. D.*

To this affection, various other names have been applied, by the different writers who have treated of it. It is called suffocatio stridula, angina polyposa, asthma infantum, cynanche stridula, angina epidemica, morbus strangulatorius; and in popular language, croup, or hives, the heaving of the lights or lungs, the choak or stuffing, &c. The best nosological title is, *Tracheitis.* It clearly designates the more ordinary nature of the complaint, and at the same time gives uniformity to our medical nomenclature.

Croup has commonly been considered as a disease of modern date; and the credit of having originally noticed and described it, is accorded to Professor Home of Edinburgh, whose publication appeared about the middle of last century†. Turning over, however, one of the earliest volumes of the Transactions of the Royal Society of London, I find a very distinct account of the disease, illustrated by dissections. The writer, who was an obscure practitioner, describes it as an entirely new complaint, which had suddenly appeared among the children of Cornwall, committing very considerable ravages. It is also said to be particularly noticed by Martin Ghisi, an Italian writer, so early as 1749.‡

Croup is, for the most part, confined to the early period of life, embracing the space between the first and fifth year; and affects chiefly children florid and robust. But I have known it to attack infants within the month, and also adult subjects. The illustrious Washington is said to have died of this disease. Two ladies of Philadelphia, who are now nearly in the meridian of life, I have attended in re-

* From the Philadelphia Journal of the Medical and Physical Sciences.

† 1765.

‡ There is, indeed, some reason to suspect that several of the much older authorities meant this disease, in the descriptions which they contain of a very fatal species of angina, *without swelling of the throat.*

peated attacks of croup. So strongly, indeed, are they predisposed to it, that they scarcely ever escape when exposed to the causes. The same liability has been transmitted to all their children, who are now numerous.

By some writers, however, it is asserted that croup never occurs after the age of puberty. That it is a rare event, cannot be denied. Nor, perhaps, is the fact without explanation. The parts constituting the seat of the disease undergo, at this period, a change, as is evinced by the new tone of voice acquired; which change enables them to resist those causes, that, in the previous state of debility and relaxation of the larynx, more especially, were liable to such morbid aggressions. Cases of this kind, however, are still to be considered as rare and anomalous deviations from the ordinary course and character of the disease.

Notwithstanding what has been so confidently alleged to the contrary, there is not the slightest reason to believe that croup is ever propagated by contagion. It would seem chiefly to arise from the influence of a moist and cold or austere atmosphere; and hence prevails more generally in the spring than at any other season, and near to the sea, or other large collections of water, rather than in inland positions.

By some writers it is affirmed occasionally to occur as an epidemic; and perhaps this may be true. It is certain that the complaint is endemial to particular places, and within very narrow limits. Many situations on the sea-coast are so particularly exposed to it, as almost to preclude the raising of children.

Croup has been divided into spasmodic and inflammatory; and not a little discussion has taken place on this subject. It would seem to me, that in all cases where it suddenly attacks, it must partake of the nature of spasm. Time is required to induce inflammation, which consists in an altered action of the vessels of a part affected by comparatively a slow process. No cause, however, more ra-

pidly promotes it than the disturbance occasioned by spasmodic constriction.

The early symptoms correspond with this view of the pathology of croup; and dissections fully confirm it, shewing, where death promptly takes place, none of the phenomena of inflammation. But, under other circumstances, where the disease slowly approaches, or is the effect of inflammation of other parts, extending to the trachea, as sometimes happens in measles, scarlet fever, and most of the anginose affections, then it is of a contrary character, and *post-mortem* inspections have revealed exactly such appearances as might have been anticipated.

Even, however, admitting the distinction contended for, I am not aware that it leads to any practical difference. Whether *spasmodic* or *inflammatory*, the directly depleting measures will be found equally effectual in treatment. No remedy is so prompt in the reduction of spasm of high action as venesection, and none so unavailing or inappropriate as the antispasmodic substances. On this point I wish to speak emphatically; since some of the European as well our own writers of high authority, entertaining other notions, have laboured to establish an opposite practice, consisting in the use of musk, asafœtida, and opium, than which nothing can be more false or prejudicial.

Croup variously makes its attacks. It commonly comes on at night, and sometimes without any premonition or exposure to its ordinary causes. The child wakes up with the hoarse, dry, stridulous cough peculiar to the disease, which has been aptly compared to the sharp sound of the barking of a dog, and in other instances to the crowing of the cock. Concomitant with this, there is a distressing difficulty of respiration, menacing, in some instances, suffocation, with a flushed face, a quick irritated pulse, an unusual degree of restlessness and anxiety, with a sort of indescribable wretchedness. The child will not remain long in one position, nor can its complaints be in any way appeased. It whines, and cries, and frets, and seems to

be excessively uneasy, without suffering any very positive pain.

Cases of this nature are probably dependent on spasm, and terminate fatally in a very short time, where relief is not afforded. But, on many occasions, the disease advances gradually, with the ordinary catarrhal symptoms, such as heaviness, suffusion of countenance, defluctions from the eyes and nose, a harder and more shrill cough than usual, and with various degrees of fever, which, with the cough, is always exacerbated at night, and especially after the child has slept. Completely formed, there is no material difference between the two species of croup, and henceforward their progrees is nearly, or perhaps exactly similar.

My mode of managing this disease is exceedingly simple; and has hitherto proved so successful, that I always approach it, in the early stages, with a greater certainty of curing it than any of the other complaints of infancy or childhood.

Called in the commencement of the attack, I endeavour at once to puke the child very freely; and for this purpose I prefer the tartarized antimony, given at short intervals, as being one of the most certain and powerful of the emetics. At the same time, I direct the child to be put into a warm bath for ten or fifteen minutes. This is a useful remedy. It rarely fails to promote the operation of the emetic, and will indeed, alone, sometimes cure the disease. The emetic however, not operating, or if after its operation the desired effect be not realized, I then bleed copiously, and repeat it and the bath. An attack must be extremely obstinate, if it do not now yield. Nevertheless, it will occasionally continue with little or no abatement; and under these circumstances, I resort to topical depletion, by leeches, or by cups. The cups should be applied to the sides or back of the neck; as when placed anteriorly, they will by pressure and suction greatly impede respiration, and sometimes endanger suffocation. Twice I have seen the distress from

this mistake so violent, that I believe death would have taken place had not the cups been removed. As means of local bleeding, leeches are very much to be preferred in such cases. Next, I put a sinapism or blister over the throat; or, in some instances, these may be made to precede the former applications.

The foregoing remedies failing, or where the symptoms become so alarmingly violent as to demand immediate relief, I bleed *ad deliquium animi.* When pushed to this extent, I may almost say, that venesection is invariably successful. As yet, I have never known one instance in which it failed. The moment that syncope takes place, the hoarseness, cough, impeded respiration and fever, disappear.

This valuable suggestion I derived from Dr. Dick, of Alexandria, one of the most original, bold, and successful practitioners of our country. It has been claimed, I understand, elsewhere;—with what justice I pretend not to determine. That however the practice was adopted, at least thirty years ago, by this distinguished physician, is unquestionable.

To prefer small and repeated bleedings at this period of the disease, as is advised by one of the most authoritative of our own writers, is a pernicious abuse of an important remedy. It may be laid down as a rule, to which there are few exceptions, that in acute diseases, where venesection is at all demanded, it should in the commencement be so copious as to produce decisive effects. The rationale of the measure seems not to be well understood. Detractions of blood in a small or large quantity operate, as remedial processes, very differently. The former *abates* action only; while the latter *alters* it; or so far reduces it as to enable the natural energies of the system to subvert or overcome it, and to re-establish health. Of this principle, we have illustrations in pleurisy, in fevers, and many other affections; where a single profuse bleeding, timely recurred to, arrests the progress of the case.

Conceding that the loss of blood is necessary to a cure,

it will be proper, under the circumstances stated, to pursue this course, even where we have grounds to apprehend debility. As small bleedings require to be often repeated, the aggregate of blood lost becomes ultimately greater, and more exhausting in its effects. Besides which, as there is less structural or functional derangement, the convalescence is more rapid and complete. Whether, therefore, with a view to a prompt cure, or to economize the resources of the constitution, or as a security against relapses or imperfect recoveries, this practice claims a preference.

The disease being broken, which is shewn by the removal of the preceding symptoms, and even still more by the restoration of the *natural susceptibility of the system to the action of Medicine*, I administer calomel; not in small and repeated doses, as is more generally advised, but in the largest possible dose, in order that it may speedily and most actively purge. In this particular stage of the disease, a thorough opening of the bowels carries off the lingering symptoms, obviates a relapse, and confirms the convalescence. But should cough or hoarseness, with tightness of the chest, and deficient expectoration, remain, I employ the polygala senega as an *expectorant*. It is in extinguishing the remains of croup, that it displays, I think, not the least of its valuable properties. Doubtless, however, it may be used at an earlier period of the disease with advantage, as an emetic, though still I prefer the tartarized antimony.

[*To be continued.*]

LXXXVI.—MISCELLANEOUS.

On the Purification of Fish Oil by Animal Charcoal.

A VERY important discovery has been made in Denmark, of purifying common fish-oil, and rendering it equal to the best sperm-oil, by means of animal charcoal; which is made in a peculiar way, from beef-bones which have been boiled, doubtless by heating them in iron-retorts. The charcoal is mixed with the oil, and repeatedly agitated for two

months; after which it is filtered through twelve strata of other charcoal, *used as soon as made.* The quantity of gas evolved by the bones, in the operation of converting them into charcoal, is great; and is used for lighting the manufactory and adjacent buildings. The residuum of the filtration is mixed with clay for fuel. The loss in the process, by the oil remaining in the residuum, &c. is estimated at 15 per cent.; and the gain in the improved quality of the purified oil, at 40 per cent.; leaving a balance, in favour of the discovery, of 25 per cent.*

On the Improvement of the Public Roads.

We are anxious to point out to the notice of our readers various useful suggestions on this important subject, which are contained in a small tract published by Mr. W. Wickens; and, in particular, the shortening of the roads, wherever that can be accomplished; the levelling of the roads, by lowering the hills and elevating the valleys; the widening the roads, to allow greater freedom of passage where necessary; and the employment of more durable materials in the formation and repairs thereof. He also particularly wishes to point out the employment of the labouring poor in this beneficial manner, in the present scarcity of work. We extract the following striking passage:—

"The problem to be solved, in all rational attempts to improve public highways, is, to secure the means of communication between certain given parts of the country, with the least possible expenditure of time and labour.

"Should it be affirmed, that in these points much has been effected among us during the last few years, this much, it may with truth be replied, either is, or ought to be, regarded as nothing, compared with what yet remains to be accomplished.

"In the latter light particularly, the accelerated rate of travelling which has of late prevailed deserves to be

* No mention is herein made of the ammonia, a valuable article produced during the conversion of the bones into charcoal, or ivory-black, as it is termed in this country.—Editor.

viewed; for the system of road management in England having continued essentially the same for half a century past, and our carriages, though better constructed, being beyond comparison more loaded now than formerly, this increased celerity can only be owing to harder—the writer may safely say, it is owing only to the most merciless driving. The advantages, in fact, which we ought to have reaped, principally from the wise and careful improvement of our roads, we are now content to realize, by goading into the most unheard-of efforts the generous animals that toil upon them.

"In a cool statistical estimate of the facilities of intercourse enjoyed in this country, contained in a recent publication (the Edinburgh Review for January 1820), it is without comment related, that 'a public carriage was established not long since, in one of our southern roads, to run twelve miles per hour; but seven horses having died in three weeks, the rate is now reduced to ten miles per hour.'

"The casualties attending this cruel experiment were, doubtless, more than usually numerous; but, if inquiry is made of them, the most merciful of modern stage-coach proprietors will acknowledge, that they average not more than three years' labour from their horses; upon some roads, even not more than two.

"A calculation not widely dissimilar, will, in all probability, hold good of post-horses employed upon our main roads."

On a Wrought-iron Steam-Boat for navigating the River Seine between Paris and Havre.

THE notice in our last Miscellaneous Article on this subject has influenced the Rev. E. Forster to send us, from Paris, a notice of a Company having been formed there, to carry into effect an invention of Mr. Aaron Manby's, Director of the Horseley Company's Iron-Works near Dudley, for which he has obtained a *brevet d'invention*. This invention consists of a Wrought-iron Steam-Boat

(100 French feet in length and 21 in width) with oars on each side in place of wheels; calculated to draw but very little water, and yet to carry a large quantity of merchandize. We understand that this vessel is now lying in the Bason of the Grand Surrey Canal.

Hints and Queries on cooling Wines and other Liquids during Hot Weather.

We are requested, by our friendly Correspondent, *Investigator*, to call the attention of our Readers to the great scarcity of ice, arising from the uncommon mildness of last winter; and to invite communications on the most easy as well as economical way of cooling wines and other liquids during the hot weather, whether by rarefaction, evaporation, solution of salts, or otherwise;—and whether there be any means of bringing into common use, the method of Mr. Leslie, by means of a cheap air-pump, or exhauster, and sulphuric acid.

Steam Carriages.—A patent has been recently secured by Mr. Griffith, of Brompton; a gentleman not unknown in the literary world, by his "Travels in Asia Minor," and other works. Mr. G., in connection with a Professor of mechanism on the Continent, has at length solved the long-considered problem of propelling by steam, carriages capable of transporting merchandize and passengers, upon common roads, without the aid of horses. The actual construction of such a carriage is now proceeding, at the manufactory of Messrs. Bramah. The power to be applied in the machine is equal to that of six horses; and the carriage altogether will be twenty-eight feet in length, running upon wheels three inches broad, and equal to the conveyance of three tons and a half, with a velocity from three to seven miles per hour, varied at pleasure. The steam-engine which actuates this machine, and the body for the conveyance of the merchandize and passengers, are hung upon

springs, to prevent all shocks which might derange the machinery; and its power is transferred to the carriage-wheels through a most ingenious extension and new application of what is termed, in mechanics, "*The universal joint.*" The provisions for turning the carriage, causing it to move either forwards or backwards, and increasing or abating its speed at pleasure, are truly admirable; and the whole must have evidently called forth all the resources of an uncommon intellect.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since April 16, 1822.

To William Pride, of Uley, in the county of Gloucester, Engineer; for his self-regulating Apparatus for spooling and warping Woollen or other Warps or Chains. Dated April 16, 1822.—To be specified in two months.

To William Daniell, of Abercarne, in the county of Monmouth, Manufacturer of Iron; for certain improvements in the Rolling of Iron into the Bars used for making or manufacturing Tin Plates. Dated April 16, 1822.—In two months.

To Benjamin Cook, of Birmingham, in the county of Warwick, Patent Tube Manufacturer; for a certain mixture or preparation, which may be used with advantage in preventing the damage of accidents from fire. Dated April 16, 1822.—In six months.

To John Grimshaw, of Bishopwearmouth, in the county of Durham, Rope-maker (being one of the people called Quakers); for his improved method of stitching, lacing, or manufacturing of Flat Ropes, by means of certain Rotative Machinery, connected with or worked by a steam-engine or other rotative power; whereby the said stitching, lacing, or manufacturing of Flat Ropes is better executed than the same can be done or performed by any other method now in use. Dated April 16, 1822.—In two months.

THE

TECHNICAL REPOSITORY.

LXXXVII.—*On the Manufacture of the Pyroligneous Acid in France.**

This operation is founded on the general property which heat possesses, of disuniting the elements of vegetable matters, to re-unite them in another order, and to give birth to products which did not exist in those bodies previous to its action. The respective proportion of these products varies, not only in the different substances, but also with the greater or less degree of heat employed; and still more, on the greater or less care bestowed on the conduct and management of the process. When we distil a vegetable matter in closed vessels, we first obtain the interposed water; another portion of water is then produced, from the union of the oxygen and hydrogen of the matter; and a proportionate quantity of carbon is also formed: and, by the successive augmentation of heat, a small portion of carbon is united with the oxygen and hydrogen, to form the acetic acid; which, for a long time, was considered as a peculiar acid, and received the name of the *Pyroligneous Acid.* As the proportion of the carbon preponderates, it combines in a larger proportion with the other principles; first affording a volatile empyreumatic oil a little coloured, then increasing in colour and density, and finally becoming charged with a large quantity of carbon.

Several elastic fluids accompany the different products: the carbonic acid is disengaged, although in small

* From the *Dictionnaire Technologique*, 1822.

quantity; much carburetted hydrogen is produced; and, towards the end of the operation, a great proportion of the gaseous oxide of carbon. All the carbon which has not entered into these different combinations remains in the retort, and generally retains the forms of the vegetable matters which furnished it.

Since we have attempted to reason upon the various operations in the Arts, and to bring them upon a level with the Sciences, such improvements have been introduced into several branches of manufacture, as we could never have thought them susceptible of. Hence the cause of the singular improvement in the process of carbonizing wood, and of our being able to obtain, with considerable profit, the several products which formerly were entirely neglected. To carbonize wood in the forest, we dispose it in conical heaps; leaving, at the bottom of each, spaces sufficiently large to begin the combustion; and then cover the whole with earth, so as to form a kind of oven. Around the upper parts, crevices or chimneys are here and there made, to suffer the smoke and vapours to escape. The construction being completed, we introduce the ignited combustibles. Combostion then ensues; the water contained in the wood is dissipated; and when the heat has attained a certain degree of intensity, and is uniformly diffused, we close the mouths of the apertures. The elevated temperature of the mass is preserved a long time; the carbonization continues; but the combustion ceases, for want of the access of air.

But we now operate in a very different manner, and, in the end, obtain better results. We put the wood to be charred into very large circular or square vessels, (see Plate XX. Fig. 1. A.) made of iron-plates rivetted together, and having at their upper part, on one side, a small cylinder, made also of iron-plates. To the upper part of the vessel is adapted an iron cover (B), which is secured to the vessel with pins and keys. This vessel, so closed, forms, as the Plate shews, a very large retort. When this is prepared as above described, we lift it by means of a large crane

(C); and place it in a furnace (D), made of a form corresponding with that of the vessel; and the mouth of the furnace is covered with a lid (E), surrounded with brick-work. The whole being thus disposed, the heat is raised on the introduction of some proper fuel. The humidity of the wood is forthwith dissipated; but the vapour by degrees loses its transparency, and becomes smoky. Now is the time for adjusting the elongator, or cylinder with a handle fixed to its side. This elongator fixes into another tube of the same inclination;—which commences the condensing apparatus.

The means of condensation vary, according to local circumstances. In some manufactories, they cool by means of air, causing the vapour to pass through a long range of cylinders, sometimes through casks or vessels well fitted together: but the more common method is, to condense with water, when it is to be easily and plentifully procured. The most simple apparatus which can be used for this purpose consists of two cylinders, FF, which reciprocally envelope each other, leaving a space betwixt them sufficient for a large supply of water to pass, and, by its circulation, to cool the vapours. This double cylinder is fitted to the distilling vessel, having the same inclination. To this first apparatus a second is adapted; and frequently a third; all being exactly alike, and, to save room, returning under each other in a zig-zag form.

The water is put in circulation by an ingenious contrivance, now very much used in several manufactories. From the lower extremity (G) of the apparatus rises a perpendicular tube, which should be a little higher than any other part. At the point H is placed a very short tube, bent back towards the ground, to serve as a waste pipe. The water, furnished by a reservoir, passes down the perpendicular tube to the lower part of the apparatus, filling all the space between the cylinders. When the machine is at work, the vapours, as they condense, raise the temperature of the water; which, on its thus becoming lighter, reaches

the higher part of the cylinders, and is carried off by means of the waste pipe.

The apparatus for condensation terminates in an underground (covered) channel of brickwork, I. At the end of this channel, K, is a bent tube, to convey the liquid products into the first cistern; and this cistern, as it fills, discharges itself, by means of a waste pipe, into a larger reservoir. The tube which terminates the channel here, dips into the liquid; thus intercepting all communication with the interior of the apparatus. The gas hereby disengaged is brought back from one side of the channel, by means of a tube, L L, under the ash-hole of the furnace. This tube is furnished with a cock, M, placed at some distance from the front of the furnace, for the purpose of regulating the gas pipe, and of interrupting, at will, the communication with the interior of the apparatus. The part of the tube which enters into the hearth is raised several inches perpendicularly above the ground, and terminated in form of the rose of a watering-pot, N. By these means, the gas distributes itself uniformly under the vessel, without the least risk of the tube which conveys it being obstructed by the fuel for supplying the fire, or by the ashes.

The degree of heat necessary to effect carbonization is not very great; yet, towards the end of the process, it must be raised sufficiently to make the vessel red hot; and the length of the operation is necessarily regulated by the quantity of wood to be carbonized at the time. For a vessel which contains a demi-décastère of wood, eight hours is sufficient. It is readily known when the carbonization is complete, from the colour of the gas flame: at first, it is of a reddish-yellow colour; but afterwards becomes blue, as it then throws off more oxide of carbon than carburetted hydrogen; at last it becomes entirely white, probably caused by the vessel being hottest at this period; and the combustion, therefore, may then be considered as quite finished. There is also another method of ascertaining the completion of the operation, which

is more frequently had recourse to; that is, the cooling of the upper part of the tubes, which is not surrounded with water: they throw upon it some drops of water; and if these evaporate without noise, the operation is judged to have been sufficiently prolonged. The elongator, or adapter, must now be unluted from the vessel, and the opening into it be immediately closed by a cover of sheet-iron plates, and a luting of loam or furnace-clay. The lid which covers the furnace is next forthwith removed, by means of the crane; and the vessel itself must then be lifted out of it; which should be immediately replaced by another vessel, previously prepared. When the vessel which has been taken from the furnace is quite cold, it is uncovered, and the charcoal taken out.—A demi-décastère of wood furnishes about seven cart-loads and a half of charcoal.

Whatever may be the different kinds of wood employed for this operation, it gives nearly the same results, as far as respects the acid: but not so with regard to the charcoal. The denser the wood, the better the charcoal: and it has been remarked, that when the wood has been long left in contact with the open air, the charcoal produced from it is of a much worse quality than from that wood which is carbonized the same year it was cut. Wood exposed to the air becomes more porous and deteriorated, yielding a charcoal without strength, which readily separates and falls to dust.

Having described the apparatus employed for obtaining the pyroligneous acid, we now proceed to give an account of the manner of its being purified. This acid is of a reddish-brown colour, and holds in solution a quantity of empyreumatic oil and tar, which are produced at the same time with the acid; another portion of the product presents itself in the state of a thinner mixture. The acid is separated from these as soon as possible; which separation is readily effected, by merely suffering the heavier bodies to subside. It is above observed, that the distilling apparatus is terminated by a subterranean reservoir, wherein

the products of all the vessels are collected. A common pump communicates with this reservoir, with a pipe reaching to the very bottom, for the purpose of drawing up the tar only; which, on account of its density, sinks to the bottom: and the pump is occasionally worked, to draw off the tar. A waste-pipe is placed higher up in the reservoir, to convey the clearer acid into a waste well, from whence it is raised by another pump.

The pyroligneous acid, thus separated from the tar which is not in solution, is drawn from the waste well, into large plate-iron cauldrons; where the process of saturation is effected, either with lime or chalk. The acid, by this saturation, throws off a fresh quantity of tar, which is taken up by means of skimmers: the remainder is then allowed to settle for some time, when the remaining acid may afterwards be drawn off clear, by simple decantation.

The acetate of lime thus obtained, marks on the areometer, after washing with water, the same degree as the acidimetric degree of the acid employed. This solution is evaporated till it marks 15° of the areometer, when a concentrated solution of sulphate of soda is added. The acids thus change their bases: on the one hand, is obtained the sulphate of lime, which is precipitated; and, on the other, the acetate of soda, which remains in solution. In some manufactories, instead of following the plan we have described, they dissolve, by heat, the sulphate of soda in the acetic acid, and afterwards saturate it with chalk or lime; by this means the use of water is avoided in the solution of the sulphate; and, without any previous evaporation, a liquor is obtained equally concentrated as by the other method. In both cases, the sulphate of lime is first allowed to settle, and the clear fluid afterwards gently poured off. The precipitate is then to be washed, and the water employed to be used in new washings.

The acetate of soda which results from this double decomposition is afterwards evaporated to 27 or 28°, according to the season. When the solution has attained

this degree of concentration, it is poured into large crystallizing vessels; and at the end of three or four days, according to the size of the vessels, the mother-waters are drawn off; and from this first crystallization are obtained a plentiful supply of rhomboidal prisms, which are much coloured, with their facettes large, and their angles well defined. The mother-waters are submitted to successive evaporations and crystallizations: and when they do not any longer readily crystallize, they are evaporated to dryness, for the purpose of being converted into carbonate of soda.

To avoid uncertain trials, (which are always prejudicial, on account of the loss of time they occasion, as also from the bad results which too frequently attend them,) it is usual to calculate, before the operation is begun, the exact proportions necessary for the reciprocal decomposition; but this only becomes indispensable, when either the acid or sulphate is changed. When two salts of the same degree of saturation are susceptible of being mutually decomposed, it is necessary, to avoid an excess of either, that the quantity of real acid should be the same in both. Now this quantity of real acid is proportional to the absolute weight of the acid, and its capability of saturization; that is to say, to its acidi-metric degree, which may be represented by the product of the absolute weight multiplied by that degree. Thus, previous to saturating the acetic acid, the degree is ascertained by the areometer for acids: this degree is then multiplied by the number of kilograms intended to be employed; and the product obtained is the quantity of real acid of the whole mass which is to be made into acetate of lime. On the other hand, the degree of acid contained in the sulphate is ascertained; and afterwards, the number which represents the real acid of the acetic acid is divided by the number which represents the degree of sulphate; the result clearly denoting the number of kilograms of sulphate of soda necessary for the decomposition.

For example: supposing there are 1500 litres of acetic acid, at 8° of the areometer for acids; the real acid of the total will be expressed by 12,000, produced from these two numbers. Again, admitting that the sulphate employed marks 30°, then find the number which multiplied by 30 will produce 12,000; that is to say, the 12,000 must be divided by 30. Thus 400 kilograms of sulphate, at 30° of the areometer for acids, would completely decompose the acetate of lime resulting from the saturation of 1500 litres of acetic acid at 8° of the areometer for acids. It remains to shew how the degree of sulphate is to be known:—this is very simple. A certain weight of this sulphate is dissolved in distilled water; a somewhat smaller quantity of the solution of the muriate of barytes is added, and the solution is acidulated with a small quantity of the nitric acid. It is next filtered; then washed with distilled boiling water; then dried; and finally, the product of the sulphate is acurately weighed. The composition of this salt being well known, the quantity of acid contained in the portion of the sulphate of soda thus essayed is readily deduced, and consequently the degree on the areometer for acids which such quantity represents: always recollecting, that in the sulphate of barytes the acid is anhydrous, and that a fifth part of its weight in water must be added, to bring it to 66° of Beaumé, which is the point adopted.

We must not neglect to remark here, that, in spite of every precaution, a considerable quantity of sulphate of soda and acetic acid will always totally disappear in this double decomposition. Is it not probable, that an insoluble sulphate may be formed of the soda and chalk, like to that which is found in the *schlot* of salt-pans? if so, such deficiency will be easily accounted for.

We cannot possibly dispense with all these intermediate combinations for freeing the acetic acid from the empyreumatic products which accompany its formation. The chemist who should find means to dispense with these, would certainly derive great advantage therefrom. We

might presume that it would suffice to combine the pyroligneous acid with lime, and to calcine the calcareous acetate so as entirely to destroy the empyreumatic oil; and afterwards, by the direct action of the sulphuric acid, to obtain a pure acetic acid: but, whatever care is taken, however well the torrefaction may be conducted, the acetate of lime never produces an acid of a good quality. It is even said that the acetic acid re-produced from the purest acetate of lime (that, for instance, which has been prepared from the purified acetic acid) is very much inferior to that which served to form it. Certain it is, that, till the present time, no chemist has been able to dispense with the use of the acetate of soda. Many have endeavoured to obtain this salt by saturating the acetic acid with rough soda: the high price of the purer article is, however, fully compensated, by the saving in time and fuel: and a great inconvenience attends the employment of the rough soda; which is, that it emits an infectious odour during the saturation; a great quantity of sulphuretted hydrogen being produced from the sulphur contained in the rough soda.

The acetate of soda is easily purified by crystallization and torrefaction. This last operation, well conducted, frees it entirely from the remaining portions of tar which it may still retain. Torrefaction, to which the name of *fritte* is given in the laboratories, requires great care and experience: it is generally effected in cast-iron cauldrons, made very wide and shallow. During the whole time of the process, which generally takes twenty-four hours for 400 kilograms, the acetate must be constantly stirred with the rake: and very great attention must be paid, not to allow the temperature to rise too high, so as to decompose the acetate; yet taking care to keep up a regular heat in every part: for if the least particle of the mass begins to enter into decomposition, its progress is so rapid, as not to be stopped without extreme difficulty. The heat should never be so strong as to cause the acetate to emit smoke. When the whole is well liquified, the bubbling ceases, and

the operation is finished. The mass is then left to cool and dissolve; or, perhaps, it is better to throw it immediately into vats which contain water; but by this latter method it produces such detonations, that, to avoid danger, the vats should be sunk in the earth, and covered with thick boards strongly secured.

When the acetate is dissolved, the carbonic matter, which has arisen from the destruction of the tar, must be separated; and this presents some difficulties, because the residuum is formed of minute particles so generally diffused, that they hinder the liquid from passing the filters. The lightness of these particles will not allow them to separate by decantation, when the liquor is higher than 15° by the areometer for acids; but then they are readily got rid of. By evaporating afresh, a perfectly clear acetate is obtained; and in this state of purity it is decomposed by the sulphuric acid, for the separation of the acetic acid.

This last operation, simple as it appears, will require much precaution and experience. The acetate of soda, crystallized and pulverized, is to be put into a boiler, and then the quantity of sulphuric acid necessary for decomposing all the acetate employed. These are suffered to remain together for a sufficient time: by degrees, the acetic acid quits its combination, and rises to the surface. The major part of the sulphate of soda produced becomes deposited in the state of a powder, or in small crystals, while another portion remains in solution in the liquid. The acetic acid is separated from the sulphate of soda by distillation, and is obtained of a very fine taste and smell; but towards the end of the process, it becomes a little empyreumatic, and somewhat discoloured, so as to render it necessary to set aside this last part from the former. That which is intended for table use should be distilled in an alembic, with the head and condensing-tubes made of silver. The acid thus obtained generally marks 40° of the areometer for acids. When, however, it is wished to be produced in a highly-concentrated state, a

large proportion of muriate of lime is to be mixed with it, and then it is distilled afresh. This highly-concentrated acid is afterwards exposed to the frost, and the strongest part crystallizes. The liquor is now poured off; and the crystals are liquified, by exposing them to a temperature from 15 to 20°; and this operation is to be repeated until it congeals without a residuum, at the temperature of 12 or 13°; then it has attained its maximum, and its degree by the areometer for acids is from 88 to 90°. The anhydrous acetic acid is at 100°; that is to say, at the same degree as the sulphuric at 66°.

We shall terminate this article by an observation relative to the decomposition of the acetate of soda by the sulphuric acid. If the acid be poured in too gently, very great difficulties will be found in this operation; for the excessive heat emitted throws off so large a quantity of the acetic acid, that the workmen are obliged to fly from it. This inconvenience is prevented by adding all the sulphuric acid at once: it occupies the lower part of the vessel, and such portions only of the acetate as it touches are decomposed: the heat disengaged in the course of this re-action is consequently spread over a wide space, and produces no sensible effect. When the sulphuric acid foms an orifice, or kind of small crater, the workman, by the aid of the rake, causes the acetate to descend piece by piece, and the decomposition proceeds gently.

Such are the details we have thought it our duty to give on this branch of industry; for the first ideas of which we are indebted to that ingenious Frenchman, Lebon. It was he who invented the *thermo-lamp*. The first apparatus was constructed at Havre; with the intention of making the gas serve for the lighthouse, and the tar for the use of the shipping. But the success not being complete, Lebon was obliged to forego this enterprise; and established a manufactory for the pyroligneous acid at Versailles, near the Marly Aqueduct; the gas it afforded, serving to heat the vessels, which are now in actual use. Since that time,

the brothers Mollerat, Messieurs Kurtz, Payen, Bobée, Lemercier, &c. have formed similar establishments, and have made great sacrifices to obtain better products. Nevertheless, there is still much to do in this kind of research, which sooner or later will afford the most beneficial results.

LXXXVIII.—*On various Cements. By the* EDITOR.

[Continued from p. 375.]

ON THE USE OF WAFERS, AS AN EXTEMPORANEOUS CEMENT.

A GREAT improvement in the manner of using wafers, so as to cause them to unite or hold papers together more firmly and neatly, is, to divide or split them with a pen-knife, and thus to form two wafers out of one, of only half the usual thickness. These may be cut into small pieces, and applied, by first wetting the paper in the places to be cemented, and laying a piece of wafer on each; and then wetting the pieces of wafer, over which the other paper to be united may be placed, and pressed close: thus perfectly effecting the union. A very cheap cement is thus readily obtained; and with white wafers, owing to the thinness of the split wafer, no marks will be seen, as is the case where the entire wafer is used: the union also is so perfect, as to render separation impossible, as is sometimes effected by splitting the entire wafer.

IMPROVED GUM-WATER.

It is well known that the mucilage of gum-arabic is exceedingly liable to become spoilt by keeping. If, however, the gum be dissolved in water, and made of a thick consistence, and a little alcohol added to it, that evil will be prevented; or the solution may be made at once, in gin or other proof-spirit.

This gum-water should be kept in a wide-mouthed glass vessel, with a ground stopper, to prevent the escape of the alcohol. And although it has not the strength of the

cement described in our last Number, which is composed of gum-arabic and isinglass, yet it is very serviceable for many purposes, especially as it does not require to be heated before using.

A very convenient way of applying it to the cementing of small labels on specimens of minerals &c. is, by forming an instrument of a small common pin, stuck a little way into a slender pointed handle of wood: the head of the pin, on being dipped into the gum-water, takes up a sufficient quantity at a time; and it may then be applied, in a small spot, to each end of the label, which is generally sufficient to secure it to the specimen.

In this manner, the late John Francillon, Esq., who had one of the finest and most extensive collections of Entomology in this metropolis, cemented the numerous labels, distinguishing each specimen. And, although they were fixed sufficiently firm, yet, in case of the label requiring to be changed, as frequently happened, he inserted the point of a knife under the middle of the label, and, carrying it towards each end through the cemented parts, thus readily removed it.

These directions may appear to some unnecessarily minute; but, to others, the information resulting from many years' experience will, no doubt, be acceptable.

ON SHELL-LAC, AS A CEMENT.

This article is largely employed by the hair-workers in jewellery, to cement the hair into the collets, and thus to form it into bracelets, &c. The mode of using it is as follows: The shell-lac is put into a basin; and the basin placed in a Dutch-oven, which is set before an open fire, until the shell-lac becomes melted by the effects of the gentle heat thus applied, and can be drawn out into slender threads or rods fit to enter the small collets.

To use it, the collets must be warmed sufficiently to melt the shell-lac, *but not more;* as its utility greatly depends upon the volatile parts being preserved, which are quickly

dissipated by too great heat. The hair is then to be placed within the collets, and thus firmly secured.

In like manner, with shell-lac, the ruby cylinders of watches are firmly cemented in their sockets, by the watch-jewellers.

ON COPAL, AMBER, OR GUM-MASTICH, AS EXTEMPORANEOUS CEMENTS.

These substances may be employed, in their natural state, much in the same way as the shell-lac, forming exceedingly hard and durable cements. The jewellers use the last-mentioned article in uniting the two stones which form their *doublets*; although it would seem that copal would much better answer that purpose, from its greater hardness. Amber, also, where its colour is no objection, is yet fitter than either to effect this object, on account of its still greater strength.

ON THE RICE CEMENT.

The Editor, many years since, experienced the evils of using the mucilage of gum-tragacanth for the purpose of cementing copies of letters, which had been taken upon tissue-paper by Watt's Copying-Machine, into the copy-of-letter book, as recommended by the celebrated inventor of that machine; owing to the gum-tragacanth becoming mouldy, and the copies loosened long before the book was filled, in consequence of the dampness occasioned from time to time by the frequent cementation of fresh copies therein. In this dilemma, it fortunately occurred to him, on reading *Thunberg's Travels in Japan*, and finding frequent mention of *rice-glue* being employed there as a cement, and likewise on account of the much greater hardness of the grains of rice than those of wheat, that a cement made of rice would be very likely to answer the above purpose.

He accordingly made trial of *rice-flour* (then ordinarily sold as a substitute for starch in hair-powder), by mixing it, in a proper vessel, with cold water, and then gently sim-

mering it over the fire; when it readily formed a delicate and durable cement, not only most admirably fitted for the above desirable purpose (as the copies of letters once cemented with it never became loosened), but also for a great variety of other useful objects, and particularly for joining together paper, card, &c. in forming the various beautiful and tasteful ornaments which afford so much employment and amusement to the ladies, for which use its whiteness is most admirably adapted.

It should be observed, that *rice-flour* (not *ground rice*, which is in coarse grains) must be employed to form this cement; and also, that not more than is likely to be soon used should be made at a time; as, owing to the saccharine matter contained in the rice, it soon decomposes and becomes sour, more especially in warm weather.

ON GLUE, AS AN EXTEMPORANEOUS CEMENT.

This article, sawn into slips, is of great use to artists, in cementing paper, vellum, &c. to their drawing-boards, in the following manner.

The paper, &c. being damped upon its back, by means of a wetted sponge, and laid upon the drawing-board, the end of the slip of glue is to be dipped into hot water, and rubbed between the edges of the paper and the drawing-board, so as to apply a slight coat of stiff glue to both: the paper is then to be rubbed down hard upon the board, until the union is effected; and, in case of the paper becoming loosened in places by its stretching and tightening as the water evaporates, the same process is to be repeated.

When the drawing is completed, the paper, vellum, &c. may be readily taken off the board, by inserting an ivory folding-knife between it and the board. And what little still remains adhering to the board, may be removed, previously to cementing another paper upon it, with a sponge and hot water.

For this useful process, the Editor acknowledges his

obligations to that ingenious Mechanical Draughtsman, Mr. Joseph Clement, of Lambeth.

VARLEY'S CEMENT.

For this cheap and highly-useful cement the Editor is indebted to the late truly-scientific mechanic, Mr. Samuel Varley. It is made as follows.

Take sixteen parts, by weight, of black resin, the same quantity of whiting, and one thirty-second part of bees'-wax.

The whiting, finely powdered, must be previously heated red-hot, to expel all moisture; and be suffered to cool, before adding it to the melted resin and bees'-wax.

This cement is exceedingly useful in the various mechanical arts, and particularly in turning in general, for the purpose of cementing articles to chucks &c. in the lathe. It is also used in watch-jewellery, to hold the rubies, &c. fast, in turning and drilling them in the lathe: for this purpose, however, Mr. Seymour, formerly a workman of Mr. Varley's, thinks that *chalk* in its natural state, finely powdered, is preferable to the washed chalk or whiting; and he also varies the proportion of the bees'-wax, according to the warmth or coldness of the weather.

It will be seen that the *resin* forms the chief binding ingredient in this cement; the bees'-wax being added merely to give it toughness.

GLUE FROM TANNED LEATHER.

It is generally thought that the process of tanning renders leather exceedingly insoluble. Means, however, have been found to overcome that insolubility, and to form a glue exceedingly well adapted to the purpose for which it has hitherto been used; namely, that of making the *black-paper cases*, so much used for a great variety of purposes;—as it not only forms the cement by which they are glued together, but also, in consequence of the gallic-acid contained in it, strikes a black colour, by the application of a solution

of sulphate of iron (green vitriol, or copperas) to the surfaces of the articles; and lastly, serves to varnish the cases.

The process for making this glue is as follows: Boil the scraps or cuttings of thin tanned leather; such as the upper-leathers of boots, shoes, &c. are made of, in stale urine, until they become softened, and will stretch and contract, when pulled and let go again, in the manner of India-rubber: they are then to be washed in clean water, and boiled in water until dissolved to a proper consistence for use.

It is very singular that this useful process has been hitherto confined to the above branch of manufacture; and has never, to the best of the Editor's knowledge, been before published.

ON THE FRENCH GLUE FROM BONES.*

This is made at Paris, by M. Robert, in the following manner.—The bones used, are those only which, previous to this discovery, answered no useful purpose, except for the fabrication of phosphorus, ammonia, animal charcoal, bone-ashes, or manure; such, for instance, as those of the head, ribs, &c. &c. The refuse of the legs of sheep and calves, &c. which had been already partly used for the purposes of the toy-men *(tabletiers)* are also used for this purpose, after extracting as much of the gelatine and fat as can be done by ebullition. When the heads of oxen are to be operated upon, they begin by extracting the teeth (these being reserved for the fabrication of ammonia, as affording a greater proportion of that alkali than any of the other bones): they then break the skull, in such a manner as to preserve all the compact parts in as regular forms as possible; these pieces present a surface of from twenty to thirty inches square, and are put to soak in a mixture of

* Extracted, with alterations, from *Silliman's Journal of Science and the Arts.*

muriatic acid and water. The muriatic acid used marks about 23° of the *areometer*, and is diluted by water to about 6°. Four parts of the liquor is used to one part of the bones. They are left in this state, in open vessels, until a complete solution of the phosphate of lime has taken place, and the gelatinous part of the bone remains in its original shape and size, and is perfectly supple. When this operation is finished, which commonly last six or eight days, the gelatine is put into baskets, being first drained; and is immersed a short time in boiling water, in order to extract any small remains of grease, which would deteriorate the gelatine, and also to extract any of the acid which might be lodged in the pores. It is then carefully wiped with clean linen, and afterwards washed in copious streams of cold water, to whiten it, and render it more transparent: it is then put to dry in the shade. This is used for making glue of a very superior quality.

The inside of the bones of sheeps' legs furnish a sort of membranous glue, which supplies with advantage the place of isinglass, in the fabrication of silk stuffs.

Remarks on this Process, by the Editor.

Glue is generally made in this country, as is well known, from the skins of animals. The Editor would, however, wish particularly to call the attention of persons to the great superiority, in point of strength, of the glue made from bones, over the best English glue; as appeared from various trials made with it by a skilful English workman at Paris, in comparison with that of the best glue made in England, and on the result of whose experiments he has every reason to place absolute confidence. It surely is highly necessary that endeavours should be made in this country, with a view of re-establishing the preference hitherto shewn to the English glue: and indeed there has lately been a Patent taken out for a new method of manufacturing glue from bones, by means of steam.

ON GLUE CASTS, AS SUBSTITUTES FOR SEALING-WAX OR WAFERS.

These ornamental substitutes for wafers are now in great request; and are taken from gems, seals, or Tassie's copies thereof, in the following manner:—A solution of Salisbury glue, in water previously tinged red, purple, yellow, &c. by brazil-wood, log-wood, turmeric, &c. must be prepared, of a proper consistence. The hollows of the gem, &c. must then be moistened with a little weak gum-water, in which any white or coloured opake powder is mixed; or with the gum-water alone, and the colour in powder sifted over it: all the colour must then be wiped off the plain parts, leaving it only in the hollows. As much of the melted glue must then be poured upon the gem as can lie upon it, and be suffered to dry, in a gentle heat; when it will shrink considerably, so as to become not thicker than an ordinary sheet of writing paper: it readily quits the gem, presenting a beautiful cast of it.

To use it, the folded note, letter, &c. should be wetted on the part where the glue-wafer is to be applied, and the back of the wafer be placed upon the wet part; when it will soon adhere, by its glutinous property, and thus form an elegant closure to the letter.

It should be remarked, that this is merely the revival, and application to a different purpose, of a well-known process, formerly much used for taking casts from medals, coins, &c. viz. by making a solution of isinglass in proof-spirit, straining it clear, and pouring it over the surface of the medal, &c. The isinglass shrinks in drying, and will readily quit the surface of the medal: it may then either remain in its transparent state; or, by breathing upon it, a coat of leaf-gold or silver may be applied to it, and thus give it the appearance of metal.

LXXXIX.—*On a new and cheap Ship's Pump, invented by* Jacob Perkins, *Esq.**

29, Austin Friars;
January 10, 1820.

Sir,

I beg to submit, for the approbation of the Society for the Encouragement of Arts, Manufactures, and Commerce (of which I have the honour to be a member), a model of a Ship's Pump; which has the advantage of being capable of being constructed of materials always to be found on board, and by any ship's carpenter, without the necessity of boring the barrel, as in the usual pumps: the construction of the valves in the piston and foot-valve will also be found exceedingly easy, and to afford a large water-way; and, although the principles on which they are constructed is a modification of one of the objects of a patent granted to me, yet, should the Society approve of it, I am willing to wave any advantage from it, in favour of the British Public.

The construction of this pump is so simple and obvious, that it scarcely requires any explanation; but, should the Society require it, I shall be happy to attend the Committee appointed for its examination.

I am, Sir, &c. &c.

A. Aikin, Esq.
Secretary, &c. &c.

Jacob Perkins.

The object of the peculiar modification of this pump is, that of enabling sea-faring people to construct a pump while at sea, from materials always to be found on board; viz. deal-boards or planks, leather, nails, canvas, and tar.

This pump is constructed as follows:—Take four strips of deal-boards, of suitable width and length; nail them firmly together, so as to form a square trunk: this trunk is next covered entirely with tarpaulin; then another layer of boards is nailed over the trunk, observing to break the joints (see figs. 4 and 5. Pl. XXI.) A third layer of

* From Vol. XXXVIII. of the Transactions of the Society for the Encouragement of Arts &c. &c.—The Society voted the Gold Medal to Mr. Perkins, for this Invention.

boards, nailed firmly to the first and second layer, will complete the body of the pump, if of a common size (say five inches); but if the pump is larger, it may be strengthened by adding more layers of boards. For the form of the valves, see fig. 3. The substitute for the upper box of the common pump consists of two isosceles triangular valves, the sides of which are double the length of the base, jointed with leather to two square pieces of boards (hard wood, if convenient). These two pieces of board, to which the valves are jointed, play diagonally in the pump (see figs. 1 and 2). Between these two pieces of board, is fastened, with nails, the pump rod, which is also made of deal board: the leather which forms the joint should be extended over the sides of the valves, so as to form the stuffing, as the valves lie obliquely in the angles of the pump. The inside of the valves may be loaded with sheet-lead, if convenient: at any rate, they should be filled with as many nails as the valves will hold without weakening them. The upper valves are furnished with a check-string (see fig. 3, valve B), to prevent the friction of the valves on the sides of the pump; this check, which may be made of small line, is very important to the ease of working the pump: it should be so adjusted as to prevent the valves from resting on the sides of the pump: the leather only should touch the pump. The lower valves, which are fixed to the bottom of the pump, are made similar to the upper valves, with the exception of the rod and check. Between the lower valves a piece of hard wood, for hooking up the valves, if no sheet-iron or copper is at hand, should be fastened (see fig. 3, valve F).

This pump works very easily, owing to the water-way by the valves being much greater than the water-way through common boxes. It is not liable to choke, in consequence of the water not being *wire-drawn* below the boxes or valves; for the water-way below the valves may be so contracted as to draw up even iron; but, by enlarging the bottom of the pump, this will be remedied.

Remarks by the Editor.

From the above description of this truly novel and ingenious Pump, it will be seen that it is most admirably adapted for the intended purpose, namely, that of being speedily constructed, on the spur of the moment, of materials always at hand, and by any common carpenter; and not only so, but that it is also equally applicable to a great number of other purposes, where a cheap and useful pump for lifting water a moderate height is required; and particularly for the purposes of agriculture, for raising water for irrigation, &c. &c.;

We understand from Mr. Perkins, that an American ship, which had sprung a leak, was actually saved by constructing one of these pumps in the exigency.

References to the Engraving of Mr. PERKINS's *Ship's Pump,* Plate XXI.

Fig. 1, a side section of the pump.

Fig. 2, a diagonal section of ditto.

A A, body of the pump, figs. 1 and 2.

C C, pump rods.

D D, upper valves.

E E, lower valves.

Fig. 3, upper and lower valves; B the upper, F the lower valve.

Fig. 4, upper end of trunk.

Fig. 5, lower end of ditto.

The dotted lines mark the places in which the sections figs. 1 and 2 are taken.

XC.—*On Iron and Steel. By the* EDITOR.

[Continued from page 380.]

ON HORSE-NAIL-STUB IRON, FOR GUN-BARRELS, OFFICIAL SEALS, STOP-COCKS, &c.

OLD horse-nails, which, to be fit for use, are necessarily made of the softest and toughest iron, are collected through-

out the country, on purpose for this use: these are first agitated and rubbed against each other, in an angular box of iron, turning round continually until the greatest part of the rust which was upon them when collected is rubbed off: they are then straightened, and driven tight into hoops of iron, with the heads and points opposite to each other, till the hoop will hold no more; when the mass is fit for being welded, and drawn out into bars, or into any other form, for use, as a very soft veined iron, for making twisted gun-barrels and large office-seals, which latter, after being engraved, are case-hardened; and also for making stop-cocks, and other apparatus for performing experiments in Chemistry, wherein mercury is employed, and the use of brass must be consequently excluded.

IMPROVED MODE OF MAKING TWISTED GUN-BARRELS.

Instead of using horse-nail-stub iron alone, as in the last article, the gun-barrel makers now weld together bars of steely iron; such as the old sable Russian iron, and soft stub-iron, laid alternately upon each other in regular order; thus forming striped ribbands for the twisted barrels.

Where they wish, however, to produce curls, they first twist those compound bars, draw them into small square rods, and weld them, with the twists disposed in contrary directions, upon plates of plain iron, which forms the inside of the barrels; when the whole is drawn into ribbands, and used as before described.

Another beautiful variety is also produced by welding small square rods of striped iron, and others of twisted iron, upon plates of plain iron; thus producing a regular succession of striped and curled twists in the gun-barrels made thereof.

ON ANNEALING IRON AND STEEL WITHOUT OXIDING OR SCALING IT.

This is done by inclosing it in closed cast-iron vessels, and surrounding it with ground flint, such as is used in the manufactory of pottery; and then exposing the vessels to

a red heat, in proper furnaces. It is likely that fine loam might also answer for this purpose.

In this manner, Mr. Corcoran, of Mark Lane, wire-weaver, many years since, annealed his iron-wire so perfectly, that, although quite flexible and pliant, yet it was as bright as though it had not been heated at all.

Another method is, to inclose it in melted lead, in cast-iron vessels; the surface of the lead being covered with charcoal, to prevent oxidation; and to let it nearly cool, before taking out the iron or steel. In this way, the late Mr. John Burr, Millwright, of Hales-owen in Shropshire, annealed steel-wire for the needle and fish-hook makers.

ON ENGRAVING AND EMBOSSING STEEL.

Steel, after being polished, may be engraved in the manner of etching, as follows:—

Of the Etching-Ground.

An etching-ground must be made of melted bees'-wax; to which one-fifth part of pitch, by weight, may be added, more or less, according to the warmth or coldness of the weather. This composition must be poured, while hot, into cold water, and formed into balls for use.

To use it, the ball must be inclosed in a double thickness of silk sarsenet, lutestring, &c.; which must be tied up at the back, to form a handle.

The steel article being heated sufficiently hot, the ball must be rubbed over it; and the etching-ground be equally spread or diffused over the surface, by means of a silk dabber, made as follows:

Of the Dabber.

This must also be made of a piece of silk lutestring or sarsenet, with cotton-wool inclosed; and be kept extended by a round piece of card, having its edge slightly cut into notches all around so as to allow it to turn up a little: the cotton-wool is laid on each side of this card, and the silk gathered up at the back, and securely tied together.

The etching-ground is to be spread, beat, or dabbed,

with this instrument, uniformly over the whole surface of the steel to be etched; which must then be smoked over the flame of a candle, to make the ground of a darker colour. When cold, it is ready for etching.

Of the Etching-Points.

These are best made of Turkey or Porcupine quills; the former being cut to a point, in the manner of making a pen, but without being slit; and the latter made sharp at their points.

On the Acid for Etching.

This is the common spirit of salt, or muriatic acid of the shops, diluted with an equal weight of water.

The design being executed by the aid of the etching-points, the acid is to be applied in the following manner:—A slip of old linen-cloth, about two inches wide and twelve inches long, must be wrapped around the end of a piece of stick, and tied securely; but with the chief part of the cloth extending beyond the end of the stick or handle. This is to be dipped into the dilute acid from time to time, and be rubbed continually backwards and forwards over the parts to be etched, until they are sufficiently corroded: powdered whiting is then to be plentifully sprinkled upon the wetted parts, to neutralize the acid, and the whole be afterwards well washed with water, and dried: the etching-ground may then be removed, by rubbing it with spirit of turpentine.

TO EMBOSS STEEL.

A defensive varnish must first be prepared, in the following manner:—

Of the defensive Varnish for Embossing.

This is similar to the stopping-out varnish used in etching copper-plates; being a thick solution of common black resin in spirit of turpentine, made by means of heat.

This is to be mixed up on a Dutch-tile, with flake-white, by means of a pallet-knife; and be thinned with spirit of turpentine, to a proper consistence for laying upon the

steel by the aid of hair-pencils, in the usual manner of oil-painting.

The figures of the design being then drawn and filled up, the steel is suffered to stand until the varnish is become nearly dry; when, by means of a steel-point or etching-needle, the internal lines may be drawn thereon, and the whole suffered to harden. When dry, the undefended surrounding parts of the steel must be corroded away, exactly in the manner above described for etching, leaving the defended parts standing above those corroded parts, or, as termed, embossed.

AN IMPROVED MODE OF ETCHING AND EMBOSSING POLISHED STEEL.

This is effected by the employment of an, acid previously holding copper in solution, thereby avoiding the necessity of constant rubbing during the process of corrosion, as above directed, in order to remove the air-bubbles. In this improved mode, the copper is quietly precipitated, and the steel taken up in its stead, without any extrication of gas or air-bubbles. For this improvement the Editor is indebted to the kindness of Mr. Jacob Perkins, who employs it with great advantage in his siderography.

XCI.—*On the Manufacture of Japanned Paper Articles.*

This invention consists in uniting large sheets of paper with a size made of glue and the flour of wheat boiled together, in the following manner:—Two sheets are first cemented together, by coating one side of each with a layer of size, applied by means of a painter's brush: they are then laid together, and all the air-bubbles most carefully driven out from between them, by wiping, from the centre of the sheets toward their extremities, with a coarse cloth: they are then placed in a hot-closet or stove; and

when dry, other sheets of paper are cemented on both sides of them in a similar manner; and so on, until the whole becomes thick enough for the purposes intended.

These tablets are then to be sawn and worked by cabinet-makers into the required forms, just in the same way as they would treat wood; and united also, by means of glue, into tea-trays, and a great variety of other useful articles; for which, from its great strength, lightness, and durability, this composition is most admirably adapted. These articles are then subjected to the usual processes of japanning, painting, gilding, &c.

Others of these tablets are formed into buttons; first, by cutting them out into circular pieces, by means of a fly-press and proper tools, in the very same way in which metal buttons are made. These pieces are then turned in the lathe to a proper form, and holes made through them, into which metal shanks are rivetted: other circular pieces are then glued over the shanks, which form the faces of the buttons; and lastly, their edges are rounded off, and otherwise finished, in the lathe. These buttons then undergo the usual processes of japanning, &c. and are ornamented in various tasteful ways; among which, the process termed *the dip* deserves particular mention.

ON THE DIP IN JAPANNING.

This is a process, formerly very much used, to produce beautiful minute ramifications of various colours, single or mixed, upon the surfaces of japanned articles; and well deserves to be again brought into employment. It is thus effected:—

The colour, in powder, such as vermilion, lamp-black, flake-white, &c. is to be ground in spirit of turpentine, and then to be mixed with a very small quantity of japanner's gold-size, until a small portion of the mixture, applied upon the point of a pallet-knife to the surface of water, instantly flows over the water in the above-mentioned ramifications; when the article to be ornamented is *dipped* or

applied to it, and takes off the ramified colour upon its surface.

Should it be wished to blend different colours together over the surface of the article, it is only necessary, first, to apply one colour in the manner described, and then to repeat the process with other colours, ground up separately, until the desired effect is produced.

TO PREPARE THE JAPANNER'S GOLD-SIZE.

Take of linseed-oil one pound; and of gum-anime, four ounces: boil the oil in a proper iron vessel, with a close cover fitted to it; and add the gum, in powder, gradually to it; stirring it until each quantity appears to be dissolved, before adding another: when the whole is commixed with the oil, boil it, until, on taking a small quantity out, it appears of a thicker consistence than tar; when it must be strained through a coarse cloth for use.

ANOTHER PROCESS FOR MAKING JAPANNER'S GOLD-SIZE.

Take gum-anime, one ounce; asphaltum, one ounce; litharge of gold, red-lead, and brown-amber, of each half an ounce. Put these ingredients into a new-glazed earthen pipkin, large enough to hold one-third more than the whole quantity of ingredients to be boiled. Next add a quarter of a pint of raw linseed-oil, and half-a-pint of linseed-oil rendered drying. The whole must then be heated over a gentle fire, which does not flame in the least; so that the mixture may only just bubble up, or almost boil; as, should it boil and rise over the edges of the pipkin, great danger might arise; and therefore, in case of its swelling up, to prevent its boiling over, remove the pipkin from the fire till the mixture again subsides. On beginning to boil, it must be well stirred with a stick, until the soluble ingredients are incorporated, and it becomes as thick as treacle; when it may be cooled and strained, as above described, for use.

IMPROVED MANUFACTURE OF JAPANNED PAPER ARTICLES.

This improvement consists in cementing sheets of paper

together upon moulds of the shape of the articles to be made, and then drying them in stoves; instead of first making tablets thereof, to be afterwards worked into the articles, as above described. For many purposes, this is, no doubt, superior to the former method; inasmuch as there are none of the blemishes in the article thus made, which were inevitably produced in those put together by means of nails, glue, &c.; and irregular forms can be, of course, much better produced.

We have just seen an admirable imitation of the old Japanese manufacture; being a large paper tray, with a scalloped border; most beautifully japanned in raised and plain figures, with bronze powders of various colours. We understand it is intended to be presented to his Majesty, from the manufacturers at Birmingham.

ON THE FRENCH PAPIER-MACHEE.

This is formed of paper, beaten into a pulp with size, and pressed in moulds so as to form snuff-boxes and a variety of other useful articles. We were much amused, lately, by the information of a friend who had been in Paris, respecting one of the methods by which the materials for this manufacture were obtained. He observed a man, having a large basket slung at his back, and a proper instrument in his hand, quickly strip the walls of the various posting-bills with which they were covered, and throw them into his basket. He had the curiosity to follow the man to a considerable distance, and to inquire of him the use he was going to make of them: the man replied, They were for making paper snuff-boxes. And thus, both paper and paste were procured—for nothing, but the trouble and risk of stealing them!

XCII.—*On Gilding upon Glass. By the late Mr.* Richard Hand.*

TO MAKE THE GILDING-SIZE.

Take a piece of parchment, about twice the size of a crown-piece; put it into a pint of cold water in the even-

* From the *Transactions of the Dublin Society.*

ing; and in the morning beat it up for about half-an-hour, and it will be fit for use.

Next, take a small brush, and with it give the glass which is to be gilt a thin coat of the size: when it is dry, breathe upon it, and lay on the leaf-gold. When all is covered with the gold, and is become dry, rub it with a little cotton: then give the gold another coat of size, and lay on a second coat of gold, in the same manner as before: when this is dry, rub it also with the cotton; and after sizing it, lay on a coat of leaf-silver, rubbing this also with cotton: then have ready some water, made about blood-warm; put the glass which is gilt into it, and let it lie about a quarter of an hour; then take it out, allow it to dry, and proceed to varnish.

TO MAKE THE SPIRIT-VARNISH.

There are various kinds of spirit-varnish, most of which I have made and used: but as the hardest of these varnishes is the best for gilding on glass, the following, in my opinion, is most preferable.

Take of Rectified spirit of wine, one quart;
Gum anime, two ounces;
Seed lac, three ounces;
Gum mastich, one ounce.

Keep the bottle containing these ingredients in a warm place, loosely stopped, and the gums will dissolve in the spirit; the whole must then be strained through flannel, and kept for use.

This varnish, as well as all other spirit-varnishes, must be laid on the work to be varnished whilst it is warm; for either cold or moisture prevents the varnish from taking proper hold of the article upon which it is laid.

XCIII.—*Hints on Gardening. By the* Editor.

[Continued from p. 337.]

A SINGULAR MODE OF RAISING STRAWBERRIES.

The towns of Portsmouth, Portsea, and Gosport, a few years since, were so badly supplied with strawberries, owing to the difficulty of raising them there, as to be sold at very extravagant prices; they being brought from distant parts of the country. At length it occurred to a person there, to convert a chalk-pit on Portsdown Hill into a plantation of strawberries; which he effected in the following manner. He formed narrow terraces, one above another, all round the sides of the pit, covering them with earth; and planted them with strawberry-plants, which soon grew in a most luxuriant manner, their trailing runners hanging down over the edges of the terraces, and producing such abundant crops of fruit as soon to supply all the adjacent towns with this valuable article, at reduced prices.

The manner in which this beneficial result took place well deserves consideration; whether it was owing to the cold winds being shut off by the surrounding sides of the pit; or whether owing to the sun's heat being reflected by the white chalk upon the plants; or, which is most probable, owing to both these causes united, and, in addition thereto, the chalky soil itself; it being well known, that whenever a wood of beech-trees is felled on the hilly parts of Berkshire, a most plentiful growth of wild strawberries instantly succeeds it.

The late Thomas Skip Dyot Bucknal, Esq. carried this idea much farther, many years since, by covering a chalk-pit with a glazed roof, and thus converting it into a most luxuriant Vinery; an account of which was published in the Transactions of the Society of Arts &c. &c.

XCIV.—*On various Solders.* *By the* EDITOR.

ZINC, OR SPELTAR SOLDER.

TAKE brass, eighteen parts;
Zinc, or speltar, three parts; and
Tin, two parts.

Or,

Copper, sixteen parts;
Zinc, or speltar, sixteen parts; and
Tin, one part,

First melt the brass or copper, and then add the zinc and tin; and when all are well incorporated together, pour the composition into ingot-moulds.

In order to granulate the solder, heat the ingots red hot; put them into a cast-iron mortar; and, with a large iron-pestle, quickly break the ingots, and beat and rub the parts into grains; which must be sifted of different degrees of fineness or coarseness, according to the various purposes for which the solder is intended.

ON SOLDERING WITH CAST-IRON.

The cast-iron must be repeatedly heated and quenched in water, until it becomes friable enough to be beaten to pieces, and grossly powdered, in a cast-iron mortar, with an iron pestle: it must then be sifted for use.

With this, wrought-iron, or articles made of *mild* steel, may be soldered, by the aid of borax; and the joints will be scarcely perceptible, owing to the colour of the solder and the articles being so nearly similar.

Articles made of *hard* cast-steel, being equally fusible as the cast-iron, cannot, of course, be soldered by the same means.

XCV.—*On the Preparation of various Oxides of Iron, for polishing Gold, Silver, Brass, Steel, &c.* *By the* EDITOR.

ROUGE AND CROCUS.

THESE articles are manufactured at Liverpool, by persons who make it their sole occupation, in the following

manner. They take the crystals of sulphate of iron (green vitriol or copperas) immediately from the crystallizing vessels, in the Copperas-Works there, so as to have them as clean as possible; and instantly put them into crucibles or cast-iron pots, and expose them to heat, without suffering the smallest particles of dust to get in, which would have a tendency to scratch the articles to be polished. Those portions which are least calcined, and are of a scarlet colour, are fit to make rouge for polishing gold or silver; whilst those which are more calcined, or have become red, purple, or bluish-purple, form crocus fit for polishing brass or steel. Of these, the bluish-purpled coloured parts are the hardest, and are found nearest to the bottom of the vessels, and consequently have been exposed to the greatest degree of heat.—The Editor had this information from the late Mr. Samuel Varley.

JEWELLER'S ROUGE

Is prepared by persons in this metropolis, by decomposing sulphate of iron with potash; well washing the yellow oxide of iron, to free it from the sulphate of potash; and slightly calcining it, till it acquires a scarlet colour.

ARTIFICIAL SPECULAR IRON ORE.

This is made in the following manner. Equal parts of sulphate of iron and hydrochlorate of soda (common salt) are to be well mixed, by rubbing them together in a mortar: the mixture is then to be put into a shallow cupel or crucible, and exposed to a red-heat: a considerable quantity of vapour will be disengaged, and the matter will run into fusion. When vapours no longer arise, remove the vessel, and let it cool.

The mass will be of a violet-brown colour, covered with extremely-brilliant scales resembling mica, and perfectly like the *specular iron-ore.* This mass must be dissolved in water; as well to separate the sulphate of soda which is formed by the decomposition of the two salts employed, as

sisting of enamel colours, ground up with Barbadoes tar—mineral bitumen, and rubbed into the lines of engraved copper-plates, the surfaces of the plates being cleaned by scraping and wiping off the ink, as in ordinary copper-plate printing) is taken up by pressing the bat upon the inked copper-plate, and is then transferred, in a similar way, to the surfaces of the wares to be printed. In this manner, arms, crests, ciphers, and other devices, are printed, in London, upon pottery, and burnt in, or fired, in proper kilns or furnaces.

ON PRINTING JAPANNED WARES.

This has been effected in a way very much resembling that just described in printing pottery, by Mr. Valentine of Clerkenwell, in his patent for Polyzography; namely, by taking the impressions from engraved plates filled with the coloured japan, and wiped off, upon elastic balls or rollers made of a similar composition with the potter's printing-bat, and transferring such impressions to the surfaces of the japanned articles.

IMPROVEMENT IN TYPOGRAPHY.

This improvement consists in the use of elastic inking-balls, or rollers, made of a composition of glue and treacle (in some cases, with the addition of linseed-oil or resin), in place of the sheep-skin balls before employed.

The composition when melted, is either spread over the surface of coarse canvas, and formed into balls in the manner of making sheep-skin balls; or cast around the surface of wooden cylinders (mounted upon axes to turn on frames in use) placed in hollow cylindrical moulds of cast-iron made to open and close.

By the employment of this elastic composition, typographic printing has indeed been most materially benefitted: and it affords an instance of the great importance of diffusing knowledge in the useful arts more extensively as, though the elastic composition had for years been used in the art of printing potter's-ware, yet it was not till

within twelve years that the application of it to the purpose of typography was even thought of.

It was chiefly with a view of giving these important applications of the elastic compositions of glue, treacle, &c. that we published the various cements in our last Number, composed of somewhat similar materials. Yates's composition, in particular, is very much alike to it; the employment of ale instead of treacle being the principal difference: and this cement is stated to form, when cold, an elastic substance resembling India-rubber. The treacle, however, by its deliquescent property, imparts to the elastic composition the power of continuing a much greater length of time in a fit state for use; and, indeed, the balls or rollers will never become dry, although their surfaces are impaired by use: the composition must accordingly be from time to time melted and recast.

XCVII. — *Thoughts on the Pathology and Treatment of Cynanche Trachealis, or Croup. By* N. CHAPMAN, M.D.

[Concluded from p. 396.]

THE practice, as here detailed, is applicable chiefly to croup in its forming and early stages. At this period, the disease is restricted pretty much to the upper portion of the trachea; and consists either in a spasmodic constriction of the glottis, or inflammation of the membranous lining of the larynx. But, permitted to continue for ten or fifteen hours, and sometimes even in a shorter interval, it extends itself to the bronchiæ, and into the substance of the lungs, producing, sooner or later, vast collections of mucus and phlegm, or exudations of coagulable lymph, or an engorged state of the pulmonary organs with blood.

The symptoms at this critical conjuncture are materially different. Now we have all the manifestations of an interrupted and defective circulation. The lungs, loaded and oppressed, very imperfectly execute their functions. The complexion is mottled, and the cheeks have a circumscribed

flush, with some mixture of lividness. The eyes are prominent and inflamed. The pupil is often widely dilated, attended by an expression of countenance wild, haggard, and ghastly. The respiration is exceedingly laborious, with a full and disturbed pulse; or, the child, sinking under the disease, has its breathing rather more tranquil, with a weak and irregular circulation.

The symptoms in these different states of the lungs are so analogous, that it is not easy to establish, in all instances, satisfactorily, a diagnosis. But though difficult, it is a point of some consequence to be determined, as the treatment in every respect is not precisely the same. To arrive at a just conclusion, we must take into view all the circumstances appertaining to the case in its several stages, as well as the existing appearances.

Of the nature of bronchitis, and especially of that form of it which resembles catarrhus suffocativus,—or, in other words, when it proceeds from collections of phlegm or mucus or lymph in the bronchiæ or pulmonary cells,—I have mostly found that the case has had its origin in catarrh, and which has run a course more than ordinarily protracted. There is also at the time greater or less discharge from the lungs, or at least evidence of heavy accumulations of matter, with an inability to throw it up; and to which may be added, that the pulse is languid, and the surface cold and clammy: but occasioned by sanguineous congestion, however oppressive the dyspnœa may be, there is little or no cough or pituitous discharge, and, what is very distinctive, an entire absence of the *wheezing*, so general a symptom in the first case. The respiration, however, is singularly hurried, panting, and laborious. The pulse, too, is full, though irregular and disturbed, and very readily compressible. Cases of this sort, moreover, are apt chiefly to occur in florid and plethoric children, or, as I have seen, in directly the reverse, the weak and valetudinary; and generally this condition is disclosed at an earlier period in the disease.

The indication now, in each shape of croup, is to relieve the lungs of oppression, and to re-establish a free and equable circulation. To effect these purposes, the child should be placed in a warm bath, and, while there, copiously vomited by an active and stimulating emetic. The sulphate of zinc has been recommended, and is useful; though the tartarized antimony, with calomel and ipecacuanha, or the juice of garlic or onion, is preferable*.

But in the second case, having pursued the same measures, we are also very cautiously to draw blood:—taking away a little at once, suppress the flow, and watch the effect on the system. Being beneficial, we may renew the bleeding from time to time, till our views in this respect are attained.

The necessity of such extreme circumspection in the use of the remedy in this case, is readily explained. Engorgement of the great viscera, and especially the lungs, takes out of the general circulation such a large portion of blood, and confines it so closely in the part, that any considerable loss by venesection is very sensibly felt, creating, in some instances, prompt and irreparable exhaustion.

Where the lancet is altogether forbidden, cups or leeches may be substituted, and will be most serviceable on the back.

In each species of the disease, the vesicating applications are highly important remedies. The blister should be put over the breast; or, if the case be so urgent as not to admit of delay, some means of more prompt vesication may be resorted to, as cloths wrung out of hot water, or, what perhaps is better, pledgets of lint dipped in a decoction of cantharides made with the spirit of turpentine.

The subsequent treatment consists principally of the pretty constant use of expectorants; and, for this purpose, the antimonial wine, the oxymel or vinegar of squills, the

* These latter are very certain and active emetics, and will frequently succeed in exciting vomiting, when the officinal articles have failed.

decoction of Seneka snake-root, either alone, or in combination with the carbonate of ammonia, will answer exceedingly well. The hive syrup is here a very useful preparation*.

Much may also be expected, in some instances, from the liberal exhibition of calomel. At all times, an exceedingly active expectorant,—by which I mean whatever enables the bronchial structure to disengage and expel an oppressive load of matter,—it seems, under these circumstances, occasionally to operate with really a specific efficacy. There are some indeed of the respectable practitioners, both of this country and of Europe, who trust almost exclusively to it.

Calomel was originally employed in croup by the late Dr. Kuhn of this city, who prescribed it so early as the year 1770. The Scotch physicians are devoted to the remedy, and consider it almost infallible; or such rather seems to be the opinion of some of the most distinguished of their writers. By one of them it is said, "that in every case where it was employed, previous to the occurrence of the lividness of the lips and other mortal symptoms, it has completely succeeded, both in curing the disease, and in preventing any shock to the child's constitution." His manner of exhibiting calomel would appear daring, even to rashness, were we not acquainted with the insensibility of the system in this disease to remedial impressions

* This is a prescription of Professor Coxe, which I have reason to believe has justly acquired great popularity in the treatment of croup. It is prepared agreeably to the following formula; and the dose is about a tea-spoonful for a child of one or two years old.

Syrupus Scillæ Compositus.

℞ Seneka Snake-root, bruised,
Squills, dried and bruised, ā ℔ ss
Water, ℔ 8

Boil together over a slow fire, until the water is half consumed.—Strain off the liquor, and add

Strained Honey, ℔ 4

Boil them together to six pounds, or to the consistence of a syrup.—Add to every pound of this syrup, sixteen grains of tartar emetic—That is, one grain to the ounce.

See American Dispensatory, 4th Edit. p. 343.

of every description. To a child of two years old, he has given upwards of one hundred grains, in twenty-four hours.

With Dr. Hamilton, the professor of midwifery at Edinburgh, to whom I have alluded, I am acquainted; and from his high standing and character I entertain not the slightest doubt, with some allowance for an undue enthusiasm of expression, of the veracity of these representations. Nevertheless, I will not take upon myself to support or recommend his practice. The mode which I have suggested of managing this disease, at least as it appears in this country, I must think decidedly more effectual, and certainly less hazardous as well as repugnant to popular prejudices.

In the preceding history, I have delivered, very concisely, some account of the pathology and treatment of croup. It results from what has been said, that I consider it, at first, as a spasmodic or inflammatory affection of the larynx, and in its subsequent stages as one or the other of the forms of peripneumonia notha—either a congestion of the lungs with mucus or lymph, or with blood. The former I believe to be by far the most common occurrence, or usual shape, of the disease.

The practice appropriate to the several circumstances of croup, I have also endeavoured to point out with some degree of precision.

It will be perceived, that in relation to the later stages of the disease, while I maintain that the lungs are affected differently in some cases, the only distinction in the treatment suggested, is, the limitation of bleeding to the *apoplectic condition of these organs.* Though I hold the other state to be essentially bronchitis, and hence originally of an inflammatory character, still, from the early depletory measures generally pursued, such no longer exists. We have on the contrary at this time, as its product, effusions or exudations, obstructing respiration: yet wherever there is reason to suppose a remnant of inflamma-

tion, topical bleeding, at all events, may be and ought to be practised.

What, on the whole, I wish especially to call attention to, is the view which has been presented of the nature of croup at an advanced period. It is interesting, not as mere theory, but as leading to the practical improvement on which I have dwelt. Though not generally entertained or adopted, it is most fully established, as well by the phenomena of the disease, already noticed, as by dissections. To this point we have, to a certain extent, the testimony of Cheyne, who has written with ability on the disease; and the still higher authority of Baillie, not to mention other names of less distinction; all which has been confirmed by dissections, conducted in this country*.

Not a little is said of the existence of a membrane in the larynx; and to which so much is ascribed in occasioning death, that an operation has been proposed and even practised for its removal. That it does occasionally exist, cannot be denied; though I suspect rarely, as I never met with it, in my repeated examinations for this purpose.

The appearances I have observed, in dissections relating to the larynx, were slight marks of inflammation, with more

* Neither of these writers, however, have noticed the *apoplectic* state of the lungs. The venerable Dr. Bard, of New-York, who was among the very first to adopt a correct pathology of croup, says, in his Essay on the subject, published in the year 1771, *that he has found the pulmonary organs so dense and solid, from sanguineous congestion, that they exhibited the appearance of the structure of the liver.*

Baillie, in his morbid antimony, tells us, "that when the inner membrane of the trachea is inflamed, it is sometimes lined with a layer of a yellowish pulpy matter. This does not adhere very firmly to the inner membrane, but may be easily separated. It extends from the upper part of the cavity of the larynx, into the small branches of the trachea, which are distributed through the substance of the lungs. There is at the same time a good deal of mucus in the trachea and its branches, together with a mixture of pus. This is the appearance of the inside of the trachea, in patients who have died from the croup." Cheyne's account of the post-mortem appearances in the disease, so closely resembles the preceding, that I consider it unnecessary to recite it.

Vide his Essay on Diseases of Children, Edinburgh, 1801.

or less of mucus, such as is formed by all the secreting surfaces. Why I have not seen the membranous production is, perhaps, susceptible of explanation. To throw out coagulable lymph, of which it is composed, requires the vessels to be highly excited; a state which, by the copious depletion adopted in the cases that came under my notice, was probably prevented.

Even, however, were we assured of its existence, I do not know that, in ordinary cases, the operation would do more than protract life. The disease at this time has reached the lungs, and hence no relief in this way could be expected. Yet it does sometimes happen, though seldom, that it is restricted to the larynx, and that respiration may be so obstructed by the membrane alluded to, or from an accumulation of mucus, as to threaten the immediate extinction of life. By the removal of the mechanical impediment, an operation might be useful; and has actually proved so in two cases recorded in the foreign journals, in which relief was instantly afforded, and recoveries ultimately took place. I have now in my possession a drawing executed by my friend, the late professor Dorsey, representing the membrane in a position completely to intercept the passage of air to the lungs; and which, had it been displaced by an operation, as he strenuously proposed, the child would probably have been preserved.

In the estimate of this resource of our art, we ought, moreover, not to overlook the fact of the striking effect, in many cases, from the expulsion of the membrane by vomiting or coughing, and sometimes in a state of things, too, the most critical and alarming. Yet it seems that the operation, on the whole, is deemed a very desperate and precarious expedient, to be held in reserve only for the extremest emergencies, and where common measures have altogether failed.

Two causes have conspired to render croup, which is not necessarily a fatal disease, so much so, that it is placed by some writers even among the *opprobria medicorum*, and

by most practitioners is considered a highly obstinate and dangerous affection. The first is an erroneous notion regarding its pathology; and the second, the careless and feeble mode in which it is commonly managed.

An impression almost universally prevails, that children, owing to an extreme delicacy and frailty of constitution, cannot bear any very vigorous impression from remedies. As a natural consequence of such an opinion, the general practice in their complaints is extremely inert; exactly indeed of that kind, which has been facetiously described as observing a strict neutrality between the patient and the disease, neither declaring for the one nor the other.

By no narrow or partial observation, I am thoroughly persuaded that the very contrary of this opinion is true. Children, I have remarked, display an uncommon *tenacity of life*, and strength of constitution. They often survive, under circumstances which destroy adults. They have been found living at the breast of their mothers who had perished by exposure to cold, as is recorded by travellers and other writers. They confessedly resist contagion better than grown people; and when attacked, more certainly recover, not only from diseases of this description, but from all others, when properly treated.

Nor is this all. They sustain better the operation of the most active remedies, as vomiting, purging, sweating, blistering, and I add, without hesitation, *bleeding*.

During the growth of the body, the *fluids*, in relation to the *solids*, are larger in proportion, as is distinctly proved. This fulness of their vessels, and greater excitability of system, render children peculiarly liable to inflammatory attacks. Nearly all their complaints partake of this character.

It follows, therefore, that they require *oftener to be bled;* and my own experience convinces me, that venesection may be resorted to, in their cases, with more safety, and decidedly greater advantage. No one who is conversant with their diseases, and has practised venesection much in them,

can withhold his assent from the accuracy of this statement.

Endowed with superior *vital energies*, children have, moreover, very extraordinary *recuperative powers*. They notoriously recover more speedily from wounds and injuries and surgical operations; and recruit with greater rapidity, after being reduced, either by disease or by remedies of any description.

It is on this account, that while there is any indication of life, however discouraging the appearances may be, we ought never to view the case of a child, in an acute disease, as altogether desperate; but, still retaining some hope, to continue to minister to the restorative principle of the constitution: and were this course generally pursued, I am persuaded that we should not unfrequently be rewarded by such cures, as reflect lustre on the art, and give to our skill a glorious triumph.

To do this, however, in the disease before us, the practice must be prompt and energetic, and our attendance unremitted till relief is afforded. It is a rule with me, never to leave a child, in croup, till the alarming symptoms are over. This great degree of vigilance and attention are necessary from the rapid career of the disease, and not less from the extreme and peculiar uncertainty of the operation of our remedies in it.

As a most formidable enemy, in all its presentations, it should be attacked early, vigorously, and on the very outworks. Delay never fails to invigorate its force; and when permitted to get possession of the citadel, or, in other words, a firm hold of the system, we shall find it always difficult, and often utterly impracticable, to dislodge it.

XCVIII.—*On the Manufacture of Composition Ornaments.*

THESE are formed of glue, linseed-oil, and whiting, mixed and well kneaded together, and pressed into dies or moulds by the force of a screw-press; and afterwards dried for use. In some cases, they are employed whilst in the undried or

pliant state, for the convenience of gluing, or applying them to the round or hollow surfaces of the articles they are intended to decorate. And, in case of being formed into beads, husks, &c., strings are placed in the moulds, and inclosed in the composition, to connect them together.

ON MOULDS OF SULPHUR AND IRON, FOR MAKING COMPOSITION-ORNAMENTS, &c.

A person in America most successfully employed these moulds, in lieu of those usually made of brass, &c.; and they endured the necessary pressure without injury. They are formed by dissolving the iron scales from a smith's forge, after pulverizing them, in melted sulphur: the proper proportions may be readily found by experiment. The compound is easily fusible, and takes exceedingly sharp and accurate casts from the originals.—The Editor is indebted to Mr. I. T. Hawkins for this useful information.

There can be no doubt but that these moulds may likewise prove highly serviceable in other branches of manufacture, where moulds formed of sulphur alone, or of plaster of Paris, are too weak to endure the requisite pressure; such, for instance, as that of the *papier-mâchée*; and they might be still further strengthened, by being inclosed within hoops, bands, or cases of iron.

XCIX.—*On the Microscope.* *By the* EDITOR.

[Continued from p. 329.]

ON THE PRODUCTION OF MICROSCOPIC EELS IN PASTE.

THE Editor had in vain repeatedly endeavoured to procure these beautiful living objects for the microscope, by following the methods described by Baker and other writers on this instrument. They universally direct that *vinegar* be added to the flour paste; and this caused the failures he experienced; doubtless owing to the *sulphuric acid* which is contained more or less in the vinegar ordinarily made in this country.

To the friendship of Mr. W. Carey, Optician, in the Strand, he is indebted for the means of having these eels always at hand; it being only requisite to make a paste of boiled wheaten-flour, and suffer it to remain till it becomes sour, when it will shortly become filled with the eels. This paste needs to be kept moistened with water from time to time, or to be occasionally replenished with a supply of fresh paste; and in this way he has had a constant supply for upwards of six months.

ON MOUNTING TRANSPARENT OBJECTS, SO AS TO BE READILY VIEWED BY HIGHLY-MAGNIFYING LENSES.

For single lenses of the fiftieth-of-an-inch focus (which are much superior to compound microscopes, in the greater distinctness of the magnified images of objects which they afford, owing to their partaking of the defects of one lens only, instead of those of several,) it is evident, that, on account of the necessary thickness of the ivory forming the bottom of the cells of the usual sliders, it is impossible for the lens to approach near enough to view the objects placed between the talcs.

This inconvenience induced the Editor, several years since, to contrive another kind of slider, which should be free from that evil. The basis of this slider consists of a slip of glass, the size of the ordinary ivory sliders, with its edges and ends rounded, by means of a grooved grind-stone, in the manner usually practised by opticians. Two pieces of thin paper are prepared; one of the breadth of the glass slip, and the other a little broader: both are then folded down their middle parts, and laid within each other; and similar round holes, or other shaped apertures, are to be cut at once in the middle of both, a little less than the size of the talcs to be employed.

The narrower piece of paper is then to be cemented upon the glass slip, by means of rice-glue, isinglass, or any other proper cement; which must be carefully wiped clean off the glass in the apertures which are thus to serve the office of the cells in the ordinary sliders.

In each aperture an object is to be placed, and covered by the talc, which must be cemented fast; carefully avoiding the entrance of any cement between it and the glass slip. When all are thus fitted, the broader paper is to be cemented over the former, with its apertures corresponding with it, and its edges passing over those of the glass slip and a little beneath it, but not so as to interfere with or project beyond the apertures. Any of the cement which may have lodged upon the surfaces of the talcs must then be wiped away, carefully avoiding to injure their clearness of polish; and the slider is completed.

It will be seen that there is here only the thickness of the covering paper above the talcs, and that merely to defend them from injury. The Editor has had four such sliders in very frequent use for several years past, which are now as perfect as ever; and are exceedingly convenient under the microscope, being as easily manageable as the ordinary ivory sliders.

C.—*On Inguinal Aneurism, successfully treated by* Nathan Smith, *M. D. Professor of the Theory and Practice of Physic and Surgery in Yale College, Connecticut, U. S.**

Achilles H. Elliot, of Killingworth, Connecticut, some time in the month of June last, felt a pain in the left groin, and soon perceived a small pulsating tumor: it was situated just below Poupart's ligament, and increased pretty rapidly. On the 25th of July, with the assistance of Dr. J. Knight, professor of anatomy in this institution, I undertook the operation of *tying the external iliac artery.* The aneurismal tumor was situated in the left groin. It pulsated strongly; and, from its size, it might contain eight ounces of blood. The whole limb was considerably œdematose. We followed Dr. Dorsey's mode of operating in this case,

* From No. II. of the *Philadelphia Journal of the Medical and Physical Sciences.*

which is not materially different from that of Mr. Abernethy, who was the first that attempted this operation, and to whom we are so largely indebted for other important improvements in surgery.

The patient being placed in a proper situation, I commenced an incision about an inch above Poupart's ligament, and directly over the external iliac artery, extending it obliquely upwards, nearly in the direction of the fibres of the external oblique muscle, about three and a half inches. The skin and adipose membrane being cut through, the fibres of the external oblique were divided longitudinally, and the internal oblique and transverse cut across, which brought the peritonæum into view. I then insinuated my finger between this membrane and the muscles, down to the external iliac artery, which I readily found, and endeavoured to detach from the surrounding parts. By means of Dr. Physick's curved forceps, I then passed the aneurismal needle under the artery; but, owing to an imperfection in the needle, which was made on the spur of the occasion, it slipped out of my fingers, after I had hold of the point of it. I was obliged to withdraw it, and fix it again in the forceps; and when I brought the point out a second time, Dr. Knight took hold of it with a firm pair of forceps and drew it through, which carried the ligature under the artery. After examining, to be certain that the ligature included nothing but the artery, I drew it very tight. At this moment the patient complained of severe pain, but it lasted only a few minutes. The pulsation in the aneurismal tumor ceased immediately on tightening the ligature.

The wound was then dressed with adhesive straps, with a compress and flannel bandage over the whole, adjusted in such a manner as to afford moderate pressure on the wound and aneurismal tumor. Before we had finished the dressing, the limb of the affected side was sensibly colder than the other. The operation was performed about ten A. M. At two P. M. the left limb was warmer than the other: in the evening, I could perceive no difference in the

temperature of the two limbs. The affected limb, as well as the whole body, was in a state of perspiration, the weather being very warm at that time. The next day a pulsation was felt in the posterior tibial artery, where it passes under the maleolus internus, and the aneurismal tumor was considerably diminished. It continued to decrease, until it wholly disappeared, which happened in about four weeks. The ligature came away on the twentieth day. There was not the slightest hæmorrhage, and no unfavourable symptoms occurred during the cure. The limb was somewhat debilitated at first, but it has now entirely recovered its power. The ligature made use of in this case was flaxen shoe-thread, made small and hard; and I endeavoured to draw it so as to kill the artery in that point on which it acted. I tied with a single ligature, and did not divide the artery.

There was not the least embarrassment in the operation, except what arose from the imperfection of the needle. To remedy this in future operations of the kind, the needle should have a broad point, and be so curved as to describe nearly half a circle in its shape.

Yale College, Dec. 16, 1820.

CI.—*On Reducing Friction in Machinery. By the* EDITOR.

[Continued from p. 348.]

TO APPLY THE EPICYCLOID TO THE TEETH OF WHEELS AND PINIONS, IN CLOCK- AND WATCH-WORK.

IT is evident, that the method of applying this curve to the large teeth of wheels and pinions in mill-work is quite unfit for the small teeth of the wheels and pinions employed in the delicate movements of clock- and watch-work. It is, nevertheless, of great importance to the good performance of time-pieces, &c. that their wheel-work should act with the least possible friction; and this can only be accomplished by the application of this curve: accordingly, the

most celebrated manufacturers of these articles have long since directed their attention to the best means of applying it to the teeth of their wheels and pinions. The celebrated Mr. Robert Hynam, of St. Petersburgh, sent to the Society of Arts &c. &c., many years since, a model of his method; but, unfortunately, without any description of the manner of using it; so that it was impossible to understand it. The late Mr. Hindley, of York, the most celebrated turret-clock-maker of his day, always employed it, as did the workmen instructed by him, with the most complete success. Mr. W. Hardy, an ingenious manufacturer of time-pieces, constantly makes the teeth of his wheel-work epicycloidal: and having kindly communicated to the Editor his method of doing it, we shall here give his mode of making the cutters for the teeth of brass wheels. He forms the basis of his cutters of circular blocks of brass, with holes in their centres; having also several cylindrical holes drilled in their peripheries, in radii lines, to receive the stems of the steel cylinders, the outer ends of which are to be formed into the teeth of the cutters. These cylinders are secured, in their places in the blocks, by steel pins, driven through holes drilled both in the blocks and stems. Their outer ends are then shaped by turning in the lathe, as nearly as may be to the intended curve; but, to do it correctly, Mr. Hardy employs a circular plate of sheet-steel, about three-sixteenths of an inch in thickness, having a hole in its centre: he next makes a gap in its edge, and forms one side of the gap into the true epicycloidal and radial shapes of the teeth to be cut. He also chamfers or bevels that side so shaped, in order to enable it to cut as a turning-tool; and having hardened and tempered it, he fixes it upon the arbor of the dividing-plate of the cutting-engine, the same as if it was a wheel to be cut. The intended cutter is then fixed on the cutter-arbor of the engine, in place of the usual cutters; and both sides of the teeth upon it are successively brought into contact with the edge of the fixed cutter, by reversing

the intended cutter on the arbor; and thus the teeth receive the exact forms of their sides: their fronts, tops, and backs, must then be shaped for cutting, as usual; and, after being taken out of the block, must be hardened and tempered. They are then to be replaced in the block, for their sides to be polished by means of Turkey-oilstone-powder and oil, applied upon a piece of box-wood: their fronts and tops must then be *skive-ground* as usual, and the cutter is completed.

It will be seen, that the sides of these teeth are not reduced behind, to cause them to leave, as usual; and, in consequence thereof, and of their sides being polished, with the help of a little of the usual lubricating composition (made of tallow and olive-oil, of one part each, and two parts of bees'-wax, applied occasionally), they cut the wheel-teeth, and at the same time beautifully polish their sides.

His cutters for steel-pinions are made of solid steel-plates, toothed as usual; but their sides are accurately shaped to the epicycloidal curve and radial line, in the same manner as the teeth of his wheel-cutters.

The good effects of this great attention to the proper forms of the teeth of his wheel-work, and to the accuracy of the finish of his pivots and jewelled pivot-holes,—conjoined also with a new escapement, of his invention, for which he was rewarded by the Society of Arts &c. &c. with their Gold Medal and Fifty Guineas,—are fully evinced by the accurate performance of a time-piece which he made, several years since, for the Royal Observatory at Greenwich.

ON REDUCING THE FRICTION OF PIVOTS.

The next great source of the loss of power in machinery is, as before said, the rubbing of the pivots in their bearings. This may arise from several causes. The bearing surfaces being too small, is one very frequent occasion of friction. It is better to make them rather too large, than too small; as, in that case, every part of the pivot presses with less

weight on its bearing; and, consequently, the oil, grease, or other lubricating material employed, can more readily insinuate itself between them, and prevent them from fretting, wearing, or galling each other.

Dr. Desaguliers made many experiments on this subject; and the result was, that no square inch of rubbing-surfaces should bear more than seven hundred weight; as, otherwise, it would be impossible to lubricate them; even pitch being forced out, and the surfaces thus coming into contact with each other.

Another great cause of friction in pivots is the wearing of their shoulders. This, in many cases, may be entirely removed, by transferring the bearing against the shoulders, to parts which have much less motion. It is obvious that there is in the centre of every pivot, a part which has very little motion: if, then, this part can be made to act, in receiving and bearing the pressure endways or sideways, in place of the shoulders, they may be entirely dispensed with, and the friction thereon removed. Mr. Hardy has very judiciously done this in his time-piece at Greenwich, in all the pivots where it could apply; and fixed cocks to the frame-plates, touching the ends of the pivots, to steady them: and numberless cases are continually occurring, where the same good effect might take place.

It is however the common practice of smiths, millwrights, and other workmen employed in the construction of machines, to remove this most valuable part, by making holes in the centres of their pivots, for the convenience of turning them in the lathe; and leaving these holes when their work is finished.

Now, if, instead of this practice, they would at first make the steel-pivots a little longer than necessary, so as to allow of those perforated parts being turned off; and leave the ends of the pivots solid, and in a slight degree convex, so that their centres should project above the rest of the surfaces forming the ends of the pivots, and cause those centres, when properly finished and hardened, to come

into contact with hard flat steel-plates fixed in the plummer-blocks or carriages of the bearings; those central parts would prevent the other parts from wearing, and the friction be thus very considerably reduced.

It may be necessary to state, from actual experience, the successful results of this practice. In a large steam-mill in the country, several stories high, motion was communicated to the machinery, in the several floors from the engine, by means of an upright shaft carrying large bevel-wheels upon it, which worked into other bevel-wheels fixed upon horizontal shafts in each separate story. The lower pivot of this upright shaft, in consequence of its faulty construction and the great weight it had to carry, produced so much friction, that it was necessary to pour water upon it continually, to cool it, and prevent it from setting the premises on fire. This evil was entirely removed, by fixing another pivot in the foot of the shaft, made of hardened steel, with its end a little convex, and resting upon a hard flat steel-plate, placed on the bottom of the chair or plummer-block; the neck of the pivot being surrounded by a bell-metal socket, with four semi-circular grooves made in its lower edge, to permit oil to flow into it from the chair, which contained a proper supply of the oil: the socket was held in its place by four screws passing through screwed holes made in the sides of the chair, above the oil. This disposition entirely remedied the evil; and no further complaint was ever made, during many years that the Editor knew of this application.

Another instance occurred in a powerful water-mill for grinding and boring gun-barrels. In the operation of *rough-boring* the barrels, they are driven endways against the boring-bits, by means of levers, to be pressed against by the workmen; and so great is the friction produced by the action of the bits within the barrels, that it is necessary to pour water continually upon the outside of the barrels, to cool them, and prevent them from injuring the bits from

the heat which would instantly take place were that precaution omitted. Now, in order to guard against the friction endways of the spindles which carried the boring-bits, they had been carefully made agreeably to the principles just laid down; namely, their end-pivots being made of steel, a little convex at their extremities, hardened and tempered, and acting against hard flat steel-plates fixed in the plummer-blocks. In this manner they worked for several years, without any complaint being made on the score of friction. It happened, however, that the mouth at the opposite end of one of the spindles, into which the broad ends of the boring-bits were placed, had become worn in the course of time, and it was necessary to have it repaired. It was accordingly sent to an ordinary jobbing-smith, who repaired it in his usual manner. Very soon afterwards, the end-pivot began to heat, and could not be kept cool, even with the assistance of water poured over it: on this it was taken out; when it was found that the smith had made a hole in its centre, as usual, and, after repairing the mouth of the spindle, hardened both ends, leaving the hole so made: the consequence was, that rings or circles had formed all round the central hole, and the steel-plates had others corresponding thereto; with the addition of a pin in the middle, entering into the hole in the end of the spindle; and all this, in consequence of the centre of the spindle having been removed. On this, all the other spindles in the mill were examined; when it is was found that the steel-surfaces in contact had mutually polished themselves by the little wearing on each other, and were even more perfect than when first made. Of course, the remedy for the evil became obvious; and it was only necessary to send the spindle and plate to the workman who first made them, to restore to them their original shapes and former excellence.

Another very considerable source of friction arises from the wearing of the necks or pivots upon the brass-bearings: this may be greatly reduced, by making the necks of hard-

ened steel, and employing bearings made of *chilled cast-iron* in place of the ordinary brass-bearings. The chilled-iron castings are so hard, that scarcely any thing can act upon them; and therefore it is a matter of great importance to have them cast of the exact form, and as smooth as possible. This is effected, by placing in the sand-moulds, cast-iron blocks, made of the exact counterpart, or in relief of the hollow semi-circular bearings to be cast upon them: these blocks should also be made as smooth as possible. In this way, the necks will run in these bearings with very little friction indeed.

It may now be desirable to state, from actual experience, some of the beneficial results obtained from the employment of wheel-work constructed on the plan recommended. In the water-mill before alluded to, the wheel-work was originally made in the usual manner of millwrights; and it was thought quite sufficient for the wooden cogs to last six months without requiring renewal. The cast-iron pinions were also subject to very great wear, and, consequently, were often replaced: nor was this all, for a great part of the power of the mill was entirely lost for any useful purpose. The mill had existed during great part of a ninety-nine years lease, and was in a very ruinous state; and a fresh lease having been taken for a similar term, it was determined by the proprietor to spare no expense in renewing it, and causing the water to produce the utmost effect it was capable of: to do this, it was necessary to make some very considerable reductions in the velocity of the over-shot water-wheels, which were of sixteen feet in diameter, and run at the ordinary rate of sixteen or eighteen turns per minute, or nearly as fast as the water could keep pace with them. It was therefore determined to reduce this speed to that stated by the celebrated Mr. Smeaton, in his "Essay on the Powers of Wind and Water in Machinery;" who lays it down as a maxim, that the peripheries of over-shot water-wheels in general should never pass through a greater space than three feet per second: this

reduced the motion of the water-wheels to about three turns and a half per minute, instead of sixteen; and, of course, rendered the employment of new wheel-work unavoidable, in order to produce the requisite velocity in the various movements of the mill. Now, ordinarily, one large cog-wheel would have been employed, driving a small pinion: this great disparity, however, would have caused only two teeth to have acted upon one another at once, and would besides have had a very unfavourable effect upon their shapes: it was therefore determined to employ two wheels and two pinions, and thus to obtain the power of using high pinions, and bring three teeth into action instead of two; and, therefore, a cog-wheel of ten feet in diameter was fixed upon the mill-wheel shaft, which drove a cast-iron pinion of thirty inches in diameter, fixed upon an intermediate shaft: on this latter shaft was fixed another cog-wheel, of eight feet in diameter, which acted in a cast-iron pinion, of twenty inches in diameter, hung upon the shaft of the drum-wheel; and thus the necessary velocity was given to the drum, to drive the boring-spindles and grind-stones. The cogs of the great wheel were nine inches broad; those of the second or intermediate wheel, eight inches; and the teeth of the cast-iron pinions of proportionate breadths. All the teeth were formed truly epicycloidal, in the manner above described; those of the pinions being accurately *pitched* and *dressed* all over. The expense was, of course, very considerable; but it was only for once; as, during the many years which the Editor knew the mill, a single wood-cog was never afterwards required, and it was several years before the marks of the chisel were removed from the pinion-teeth.

Another instance of a similar nature likewise occurred in the same mill: The five fine boring-bits were driven by five cast-iron pinions, acting in each other: now, entirely owing to the improper shape given to the teeth of these pinions, they were constantly grinding each other to dust, and required to be very frequently replaced. It was accord-

ingly determined to remedy this evil. An accurately-formed pattern-wheel of soft bell-metal was made, the teeth being truly epicycloidal; and five cast-iron pinions were made from it, and set to work: and, notwithstanding that the pattern was made tapering, so as to leave the mould in casting from it, yet, as the pinions were reversed in regard to each other, no ill result happened therefrom. They were set to work directly from the casting, without being dressed at all; and, so far from wearing each other away, as before, they very soon became polished, in consequence of the very little action between them, and never needed a second supply.

Having thus stated the successful results of the employment of wheels and pinions with teeth made strictly epicycloidal, we may be permitted to make some general remarks on the evident impropriety of forming them upon any other construction. On referring to fig. 1, Plate XIX, it will be seen that three of the wheel-teeth are engaged at once in those of the pinion, and that two of them absolutely touch the pinion-teeth; the curved parts continually acting upon the radii of both wheel and pinion, and never encountering or touching each other.

We would ask, If there is any other curve capable of being applied to the teeth of wheels and pinions, so as to make them act as these do, or thus to *fit and fill each other*; and therefore to have as little drop or *back-lash* as possible, in case of the wheel driving the pinion, or the reverse taking place, as is continually happening in the working of machinery?—or one which will allow of the teeth being made equally as strong as these are? We believe it is quite impossible to answer these questions in the affirmative; and, therefore, hope it will be allowed, that *the epicycloid is the only curve proper for the teeth of wheels and pinions.*

The very same reasoning will apply to the *cycloid*, as being proper for the teeth of pinions or wheels working in racks. By referring to fig. 5, Plate XIX, it will be seen that three of the rack-teeth are engaged in those of the

pinion, and two of them in absolute contact: and let it not be supposed that they are so represented from any wish of distorting their forms to suit a pre-conceived theory, but actually because it must be so, when they are strictly generated according to the method described; as was done by Mr. Lowry, in the original Plate, of which this is an exact copy in outline. And we trust that it will likewise be allowed that *the cycloid is the only curve proper for the teeth of wheels or pinions working in racks.*

It is supposed that it can be scarcely necessary to dwell much on the *very faulty shapes* of the teeth of wheels and pinions made upon the erroneous principle laid down by CAMUS: in fact, the curves so produced are entirely spoiled; of which any one may easily satisfy himself, who will take the trouble of generating them.

In regard to the application of the cycloid to the teeth of wheels and pinions working in each other, instead of the epicycloid, as in Professor ROBINSON's method; besides the impropriety of a curve generated between a right-line and a curved-line being applied to those cases where both bodies move in curved lines, it is evident that the method admits of none of that variation in the curves of the teeth necessary to be made with the relative variation in the diameters of the wheels and pinions themselves; the curves of the wheel and the pinion being generated from each other separately, and not being capable of variation: whereas the epicycloid is generated between circles of the primitive diameters of both wheel and pinion, and varies with every difference made in them.

Having thus shewn the benefit to be derived from the proper adaptation of the cycloidal and epicycloidal curves to the teeth of wheels, pinions, and racks, and the great ease with which they can be applied, it is to be hoped that they will come into more general use than has hitherto been the case.

Our observations on reducing the friction of pivots in their bearings, being the results of sound theory skilfully

applied to practice, we conceive are deserving the notice of all persons interested in machinery.

CII.—*On an Improved Condenser.**

In addition to the zig-zag condenser described in Art. LXXXVII, p. 403, we are induced to give another, which is equally applicable, when made on a sufficiently large scale, to the same purpose as the former one; although this is chiefly intended for the distillation of odoriferous spirituous compounds (such as the celebrated Eau de Cologne, &c.), on account of the great ease with which it can be cleansed, or freed from all smell or flavour.

This condenser is the invention of Baron Gedda of Stockholm. A figure of it is given in Plate XX. fig. 2. The three tubes, AB, CD, EF, are cylindrical, about three feet three inches long, and soldered one to the other, as shewn in the figure; and communicate with each other without interruption, as we shall now explain. The tube AB must be a little larger in diameter than the adopter or beak of the still, in order to receive them within it as well as the luting. At the other extremity B, it is soldered to the end D of the tube CD: these two parts are joined by solder to a short copper cylindrical tube G, which has a male screw upon it. This tube is closed with a cap or cover H; which has a female screw well fitted to the screw on the tube G; and thus hermetically closes the two tubes at once. The two tubes CD, EF are fitted in the same manner. All the apparatus is soldered, at the points A, G, I, F, to the metallic vessel L, M, which is filled with cold water at the lower part, and renewed during the distillation. The mechanism of this apparatus is easily conceived: the vapours enter the tube A, B, where they condense: the liquor runs slowly into the tube C, D; from thence into the tube E, F; and, as it is continually in contact with the cold

* From the *Dictionnaire Technologique.*

water, it is soon raised to the temperature of the atmosphere, and escapes at the tube F. If it should be feared that this apparatus is not of a sufficient length to condense the vapours entirely, one or two tubes more may be employed, closed in the manner above described. It is not necessary that the vessel LM should be very wide; for, supposing the tube AB to be three inches in diameter, seven or eight inches will be wide enough, especially as the water is continually renewed. This disposition of the tubes affords the means of easily cleaning them. We unscrew the covers H and I, and, by the assistance of a hair-brush and water, rub the interior of the tubes till they are clean: and at the lower part of the vessel, in the most convenient place, a cock is placed for emptying the water.

CIII.—*On a Portable Furnace.* *By the* EDITOR.

THIS furnace is composed of two pieces of pumice-stone, about twice the size of the drawing in Plate XXII.; the lower one having a hemispherical excavation made in it, and the other a conical hole through it. Small as this furnace is, yet, owing to the exceedingly slow-conducting power of pumice-stone for heat, a charcoal fire will continue ignited therein for any length of time required; and keep up a constant heat, without blowing, sufficient to boil water in a Florence flask, suspended above it, for the purposes of distillation: in short, it will perform many other useful offices in the chemical practice which are now effected by the Argand lamp; at an expense so inconsiderable, as scarcely to be an object of notice, being merely that of the charcoal.

The lower piece has a a semicircular gap made in the edge of the hemispherical cavity, through which to direct occasionally the blast from a pair of bellows, when necessary to increase the heat of the fire: and both pieces are

and either colour it red with vermilion, or blue with indigo. The matches are prepared on purpose, of a round form; or they may be cut square; and must be sulphured as the ordinary matches. When the matches are coated with the mixture of which we have above described the preparation, they then constitute the oxygenated matches. In order to dry them, the uncoated ends are stuck into sand contained in proper flat vessels.

The cause of the instantaneous inflammation of the matches may be easily conceived. The sulphuric acid in which they are plunged suddenly decomposes, with the production of heat, the chlorate of potash, and also the chloric acid. The oxygen of the last is immediately conveyed to the lycopodium and the sulphur; and produces a vivid combustion, which inflames the match.

These matches are sold at a very low price, in cases containing a supply of matches, and a bottle with sulphuric acid. The bottle is usually furnished with asbestus, which retains the acid in the manner of a sponge, and does not transmit to the match more than the necessary quantity to kindle it; for if the acid should exceed the proper quantity, it would be thrown out in a manner injurious to the clothes: and the asbestus is employed for the purpose of retaining the sulphuric acid, especially because it is a mineral substance not acted upon by the acid, as would be the case with cotton or sponge.

It may be hardly necessary to say, that these matches are commonly sold under the name of the *Briquet Oxigéné*.

Remark by the Editor.—The exact proportions of the different ingredients not being here given, the Reader is requested to turn to page 249, where they will be found; only substituting lycopodium in place of starch; which is an improvement, as the matches ignite more readily, and with a less-concentrated acid.

CV.—*On preparing the Wood for the Oxygenated Matches.*

This is effected in various ways. In France, the wood of the aspen-tree, after being sawn into proper lengths, is cut, by a properly-contrived plane, into thin slices; and these again cut, in the opposite direction, into square rods for use. In England, many years since, a Mr. Tigere cut them out of willow, by a different method: he formed an instrument of a number of pieces of watch-spring, their ends being sharp and properly shaped for cutting, and fixed at equal distances apart, in a groove made in the end of a piece of willow; being exactly similar to the instrument used in basket-making, for dividing the slips of willow into slender rods. This instrument he first caused to be passed, by a boy, along the surface of the wood to be cut, and then to be instantly followed by the workman with a plane; thus forming slender square rods. Mr. James Stone, in the year 1813, contrived a rebate-plane for this purpose; the iron of which was fixed horizontally, and sliced the wood in the manner of a knife: this was preceded by a number of blades fixed across the face of the plane; which first divided the wood in the manner of Mr. Tigere's instrument, and, being followed by the horizontal knife, made the wood into square rods, at one operation, and with great rapidity. M. Pelletier, of Paris, has likewise contrived a rebate-plane, which performs the same office, and affords millions of these slender square rods in a very short time. This plane is worked backwards and forwards by means of a lever, whose fulcrum is affixed to the work-bench.

Any of these methods are preferable to the dividing of the wood by sawing, on account of the little waste occasioned in planing; and, where so many millions of oxygenated matches are to be made, it is certainly an object of importance.

It should be added, that M. Pelletier has likewise applied his improvement to the purpose of the ebonist, by cutting veneers in costly woods without loss; likewise to

that of the fan-stick maker; and, in short, to many other useful objects, where it was desirable to form wood into slender filaments or leaves with all possible economy.

CVI.—*On a Wind-Furnace, Sand-Heat, and Hot-air Closet, united. By Mr.* I. T. COOPER, *Lecturer in Chemistry.*

THESE three indispensable requisites in Chemical Analysis are now, for the first time, combined by Mr. Cooper, in a most convenient and economical disposition; as follows.

The wind-furnace is placed on the right-hand side of the apparatus, and furnished with a grate and ash-pit, as usual: the hot-air closet adjoins it, heated partly by the underside of the flue under the sand-heat, which is made of cast iron, and forms the top of the closet; thus giving out part of its heat, by radiation, to the closet as well as to the sand-heat. On the left side of the wind-furnace, a flat cast-iron tube is placed upright, which passes through the wall against which the furnace is erected, and admits a current of fresh air to enter, to be heated by the adjoining wind-furnace; there being only a fire-tile between the tube and the furnace. An upright slit is made in the wall of the hot-air closet, near its front, and at the inner end of the tube, which admits the heated air to pass into the closet, near its top, on the right-hand side. At the bottom, near its left corner, a sheet-iron tube is placed, which conveys the heated air into the chimney: and the front of the closet being closed by a sliding-door, a constant current of hot air through the closet is thus produced; which being hotter than the boiling point of water, is of most essential service, in drying precipitates, producing evaporation from the surfaces of solutions, and in performing a great variety of other useful purposes in the chemical manipulations.

The flame from the fuel in the wind-furnace is conveyed to the flue under the sand-heat, and over the top of the hot-air closet, by a horizontal slit in the left side of the furnace; the ordinary passage from the wind-furnace into the chimney being at that time shut, and its cover put on.

In this improved arrangement, that space under the sand-heat, which in ordinary cases is merely filled up with brick-work, or at most is used as a depository for fuel, is now converted into a very desirable appendage to the chemical laboratory; and will meet, it is hoped, with that universal adaptation, by the scientific world, to which its great utility entitles it.

We are promised soon to be favoured, by Mr. Cooper, with a description of a new combination of Spirit-Lamps, invented by him for the purpose of analysing animal and vegetable substances; which we shall have great pleasure in laying before our Readers, together with an explanatory engraving of it; and also a Plan and Section of the apparatus above described.

CVII.—*On Browning Copper Medals, Vessels, &c.*

This operation is effected either by means of Venetian-red or Purple-brown, being both oxides of iron: if, however, the colour of either separately is not as wished, the two may be mixed together, to produce the desired tint.

The surface of the copper to be browned being well cleaned, the powder is to be mixed with water, to the consistence of cream; and be applied, with a soft brush or hair-pencil, all over the surface of the article: it is then to be heated, over a charcoal fire, to a sufficient degree to fix the oxide upon the copper. When cold, the superfluous powder must be brushed off; and the medals may then be struck, the vessels hammered, &c.: or, if the articles are to be finished without any other operation, brushing them with a bristle-brush will be sufficient.

Some workmen hold the copper, coated with the oxide, over the smoke produced by putting a little piece of mineral coal into the charcoal fire; and when the stain produced by the smoke upon the copper begins to disappear, they judge it to be hot enough. The great difficulty seems to be in hitting the proper degree of heat; for if it be too

great or too small, the operation will fail, the copper must be re-cleaned, and the process repeated: a little experience will however soon enable the workman to determine the exact temperature.

CVIII.—MISCELLANEOUS.

REWARDS

Voted in the Society for the Encouragement of Arts, Manufactures, and Commerce, Adelphi.—[Continued from p. 318.]

To Mr. Richard Pering, Royal Dock-Yard, Plymouth; for a wrought-iron Ship's Gun-Carriage—the Silver Vulcan Medal.

To John Raine, Esq. London; for importing Sea-Elephant Oil—the Silver Medal.

To John Peart, Esq. Settle, Yorkshire, for Improving Waste Land—the Premium of the Gold Medal.

To Mr. C. A. Busby, London; for an Hydraulic Orrery—the Gold Vulcan Medal.

To Mr. A. Ainger, London; for the Improvement of Hydrometers—the Gold Vulcan Medal.

To Mr. Thomas Thompson, Coventry; for an Improved Ribbon-Loom—the Gold Vulcan Medal and Fifty Guineas.

To Mr. Arthur Biddle, Playford, near Ipswich; for a Hay-Borer—the Silver Medal.

To Mr. Thomas Starkey, Huddersfield; for Superfine Cloth, made from New South-Wales Wool—the Gold Isis Medal.

To Mr. William Wynne, London; for an Improved Hammer for Turret-Clocks—the sum of Twenty Guineas.

To Mr. Ezekiel Baker, London; for an Improved Gun-Lock—the Silver Vulcan Medal.

To Mr. Thomas Hall, Glasgow; for an Improvement in

supplying Water to Steam-Engine Boilers—the Sum of Ten Guineas.

To Mr. I. H. Abraham, Sheffield; for a Magnetic Guard for Needle- and Dry-Grinding—the Premium of the Gold Medal.

To Mrs. Sophia Wells, of Connecticut, United States; for a new Material for Leghorn Bonnets—the Silver Medal and Twenty Guineas.

To Mr. G. Savage, London; for a detached Escapement for Watches—the Silver Medal.

To Mr. W. Bailey, London; for his improved method of opening and closing Church-Windows—the Silver Vulcan Medal.

To Messrs. Cowley and Staines, Winslow, Bucks; for preserving Turnips—the Premium of the Gold Medal.

To Mr. Eustace Wigzell, London; for his Instrument for marking a Ship's Way on a Chart—the Silver Medal.

To Mr. S. Bowler, London; for his improved Rat-Trap—the sum of Five Guineas.

To Mr. W. Hookey, Royal Dock-yard, Woolwich; for his Cassoon for repairing Ships under Water—the Silver Medal.

Besides numerous Rewards in the Class of Polite Arts.

IMPROVEMENTS IN PRINTING MACHINES.

Mr. Augustus Applegath, of Lambeth, has just completed his Patent for this object. The improvements are two-fold; consisting, first, *in gaining time, by reducing the motion of the forms of types, &c. in inking them; so that two thousand impressions per hour can readily be made in Newspaper printing*;—the great advantages of which must be self-evident. The other improvement is, in the method of affording a double supply of paper to the machine, the printing or pressing cylinders of which continually revolve in one direction only.

THE BRITISH AND FOREIGN PATENT PRINTING-MACHINE.

A MACHINE under the above title, just completed by Messrs. Cooper and Miller, particularly recommends itself to the notice of the printers of Newspapers, for its rapidity of action; and to the printers of books, for its accuracy in making register. It is capable of producing twenty impressions per minute, or twelve hundred per hour, with the power of one man only to turn it: and it moves upon smooth level surfaces entirely, without the noise and friction usually occasioned by the employment of toothed-wheels or racks. The machine is now at Mr. Swan's Printing Office, in Fleet Street.

On an Hydraulic Orrery.

WE feel particular pleasure in directing the attention of our readers to an invention of a scientific and mechanical nature. We allude to the Hydraulic Orrery invented by Mr. Busby (who is an architect and engineer by profession); for which invention he has lately obtained the Gold Vulcan Medal of the Society of Arts &c. &c.

The peculiarity of this machine is, that the apparatus floats upon an unruffled expanse of water; and that the circuits, obliquities, parallelisms, and rotations of the planetary bodies, are not effected in the ordinary manner, but by certain hydraulic combinations, producing movements which admirably imitate the grand and harmonious order which reigns throughout the mightiest works of the Creator.

This apparatus, we believe, is constructed on a principle entirely new in its application to philosophical mechanics.

Mr. Busby has recently opened an exhibition of this interesting machine in the Strand.

On the Manby Wrought-Iron Steam-Boat, for navigating the River Seine, between Paris and Havre.

THIS vessel has at length sailed for its destination. We are informed that the invention of the mode of propelling it is due to Captain Napier of the royal navy. There is, however, considerable objection to the method, from the great complexity of the apparatus employed for causing the four revolving oars on each side of the vessel to enter the water edgeways, to present their broadsides in making the stroke, and again to rise out of the water edgeways,—on account of the liability of that apparatus becoming deranged when in use. We are told that there are no less than forty-eight bevel-wheels employed (twenty-four on each side) to effect these movements.

Improved Window-Sashes.

A PATENT has been lately completed by Mr. Charles Tuely, Kenton-street, for this object, which may be applied to all windows, new or old; combining strength, simplicity, and cheapness, in their construction; and obviating the necessity of getting outside, to clean, paint, or glaze them; thereby preventing the fatal accidents which so very frequently occur in the present mode of performing these operations. This improvement also prevents the sashes from shaking by the action of the wind, and materially conduces to improve ventilation.

We have been favoured by the Patentee with the following description of his invention.—The improvements in the sashes consist in making them to turn round, so that their outsides may be brought inside the room: this is done by fixing hanging styles to the sides of the sashes; the hanging-styles and sash-styles being so rebated as to render them weather-tight; and they are connected by hinges, so boxed in, each way, to the styles, as to make them very strong and durable. Neither bolts nor any other fastening are requisite to prevent their turning, when closed.

We sincerely wish the Patentee may derive that advantage from this invention, which his humane and praiseworthy endeavours so justly entitle him to expect.

LIST OF PATENTS FOR NEW INVENTIONS,

which have passed the Great Seal, since April 24, 1822.

To Pierre Erard, of Great Marlborough-Street, in the county of Middlesex, Musical Instrument-Maker; in consequence of communications made to him by a certain foreigner residing abroad, and discoveries by himself, for certain improvements on Harps. Dated April 24, 1822.—To be specified in six months.

To Edward Dodd, of St. Martin's-Lane, in the Parish of St. Martin, in the county of Middlesex, Musical Instrument Maker; for certain improvements on Pedal Harps. Dated April 24, 1822.—In six months.

To James Delveau, of Wardour-Street, in the Parish of Saint Anne, in the county of Middlesex, Musical Instrument-Maker; for certain improvements on Harps. Dated April 24, 1822.—In two months.

To Robert Ford, of Abingdon-Row, Goswell-street Road, in the county of Middlesex, Chemist; for a Chemical Liquid or Solution of Annotto. Dated April 24, 1822. —In two months.

To Richard Knight, of Foster Lane, Cheapside, London, Ironmonger; and Rupert Kirk, of Osborne Place, Whitechapel, in the county of Middlesex, Dyer; for a process for the more rapid Crystallization, and for the Evaporation of Fluids, at comparative low temperatures, by a mechanical application of air. Dated May 9, 1822.—In two months.

END OF VOL. I.

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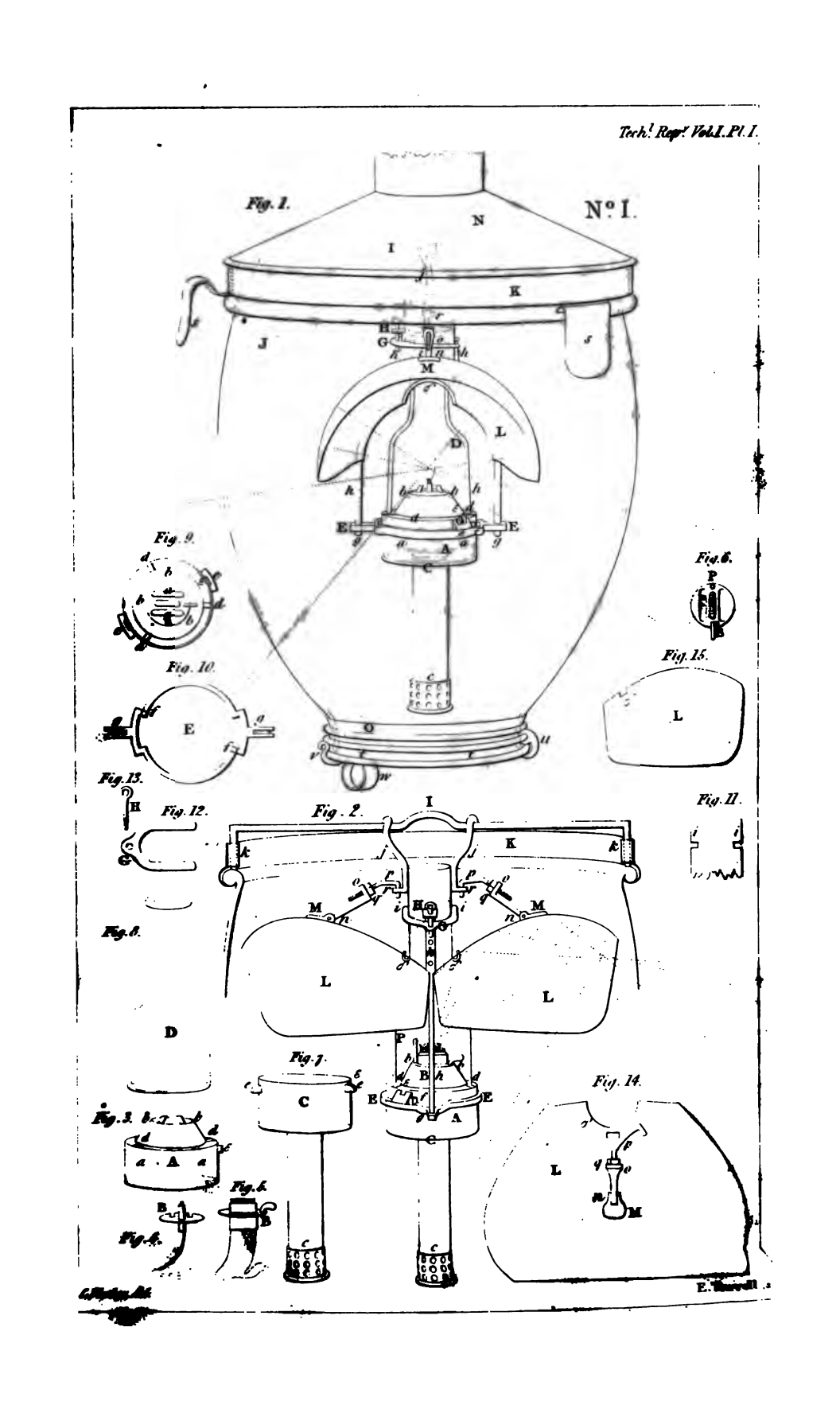
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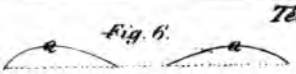

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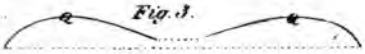

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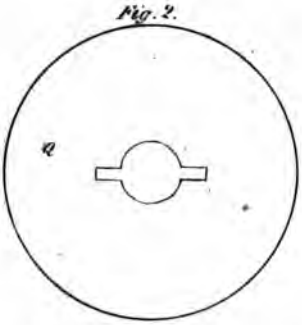

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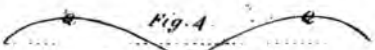

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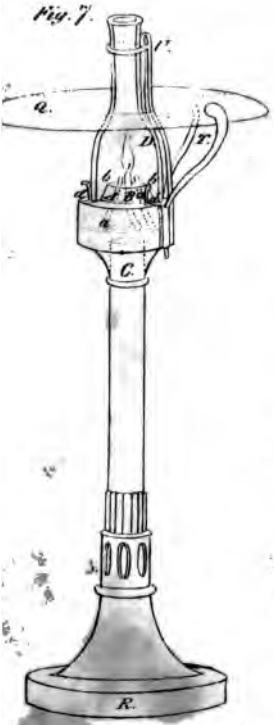

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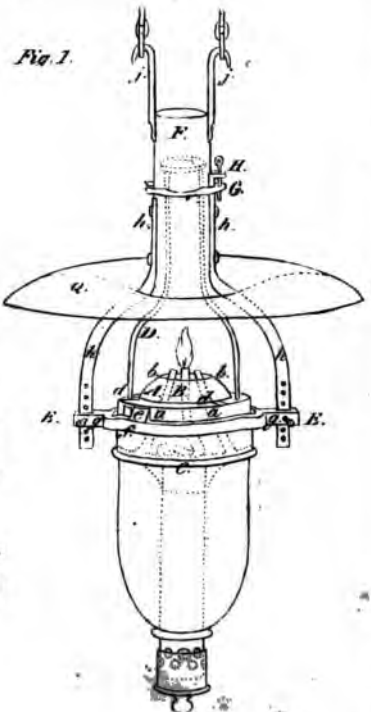

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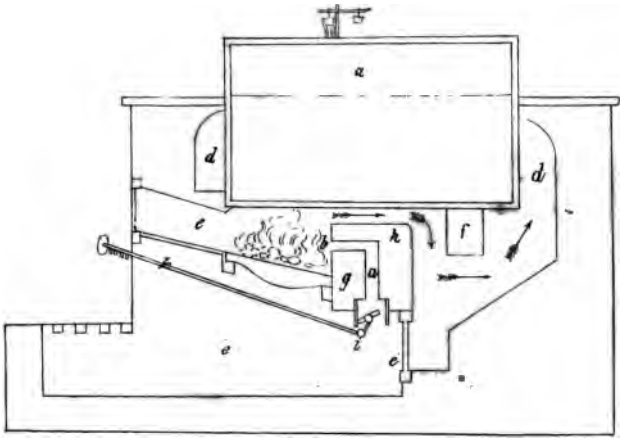

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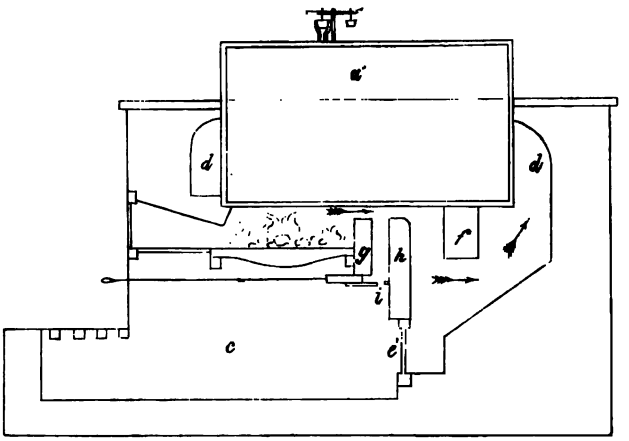

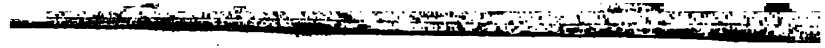

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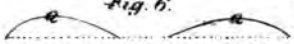

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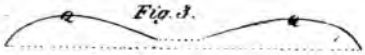

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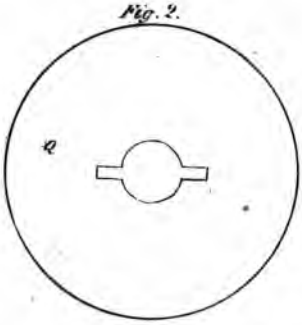

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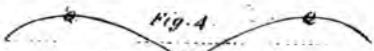

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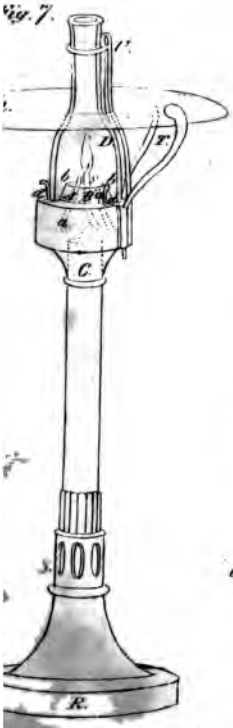

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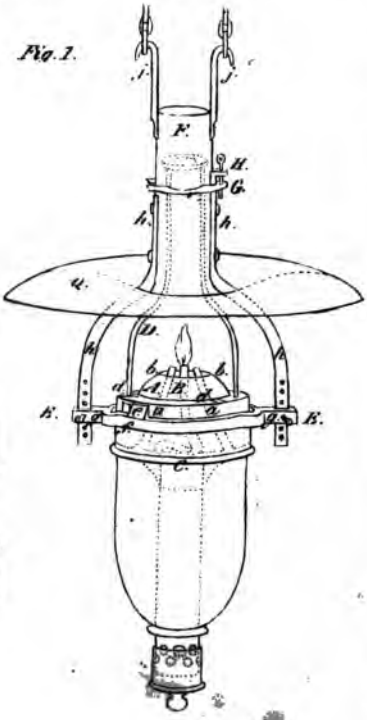

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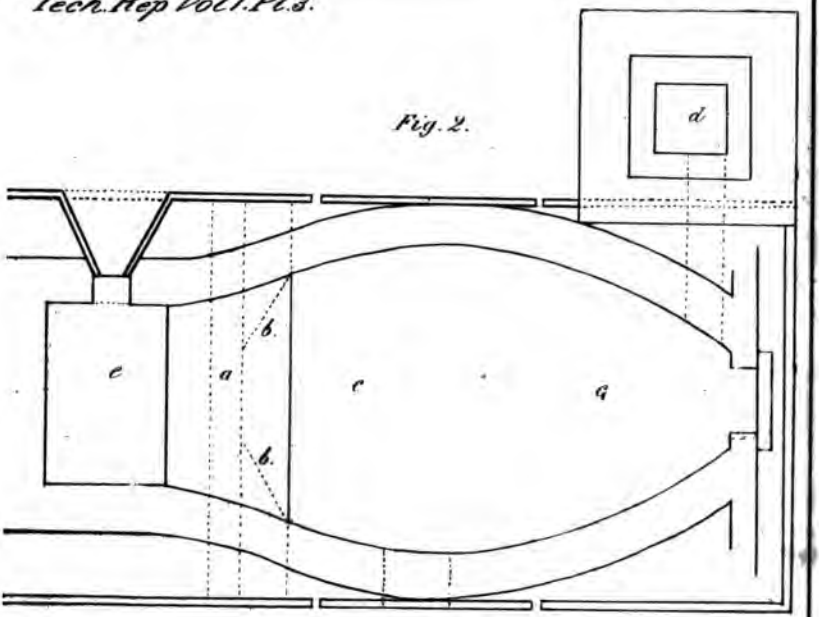

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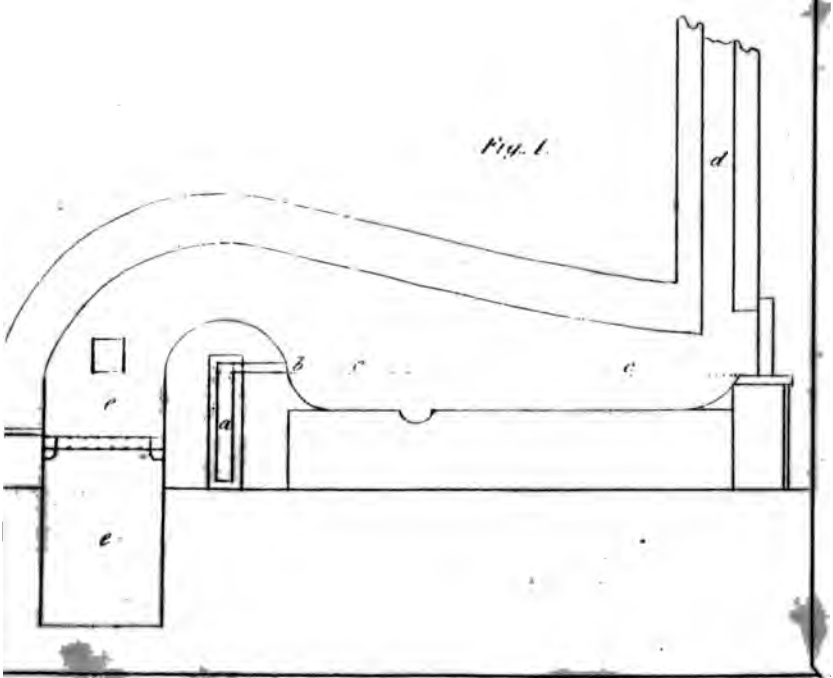

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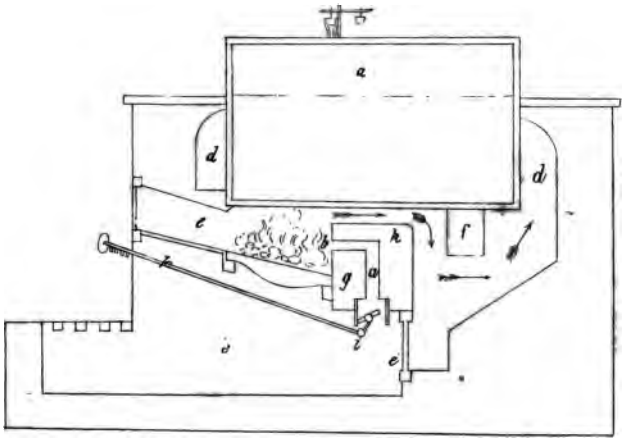

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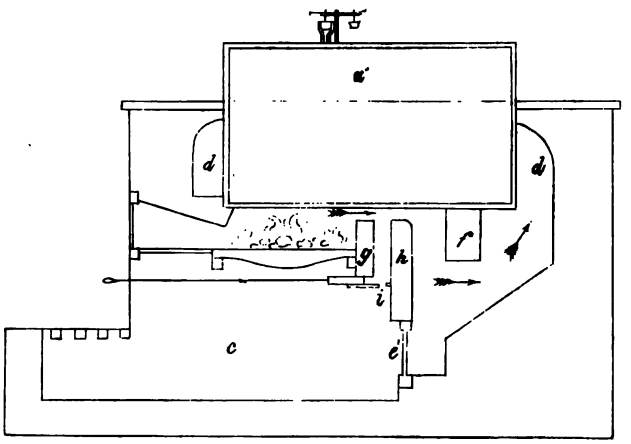

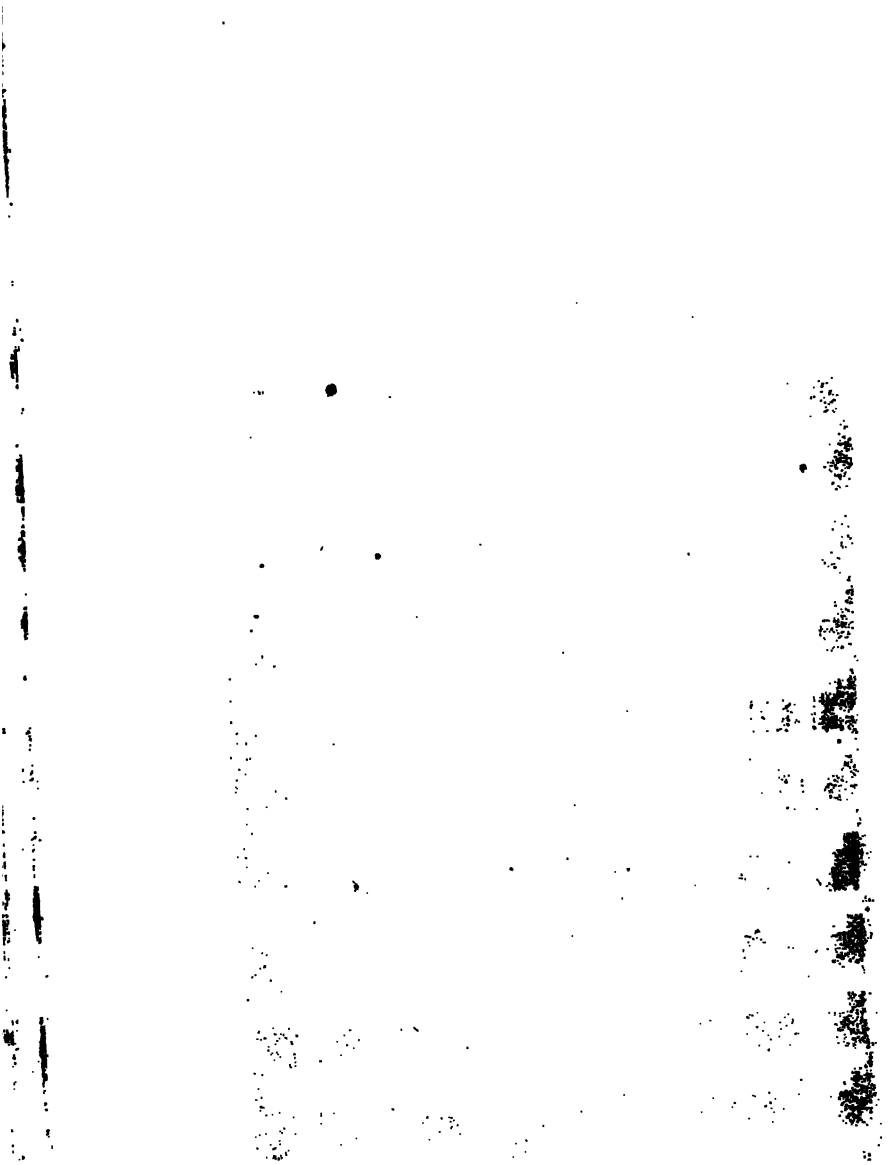

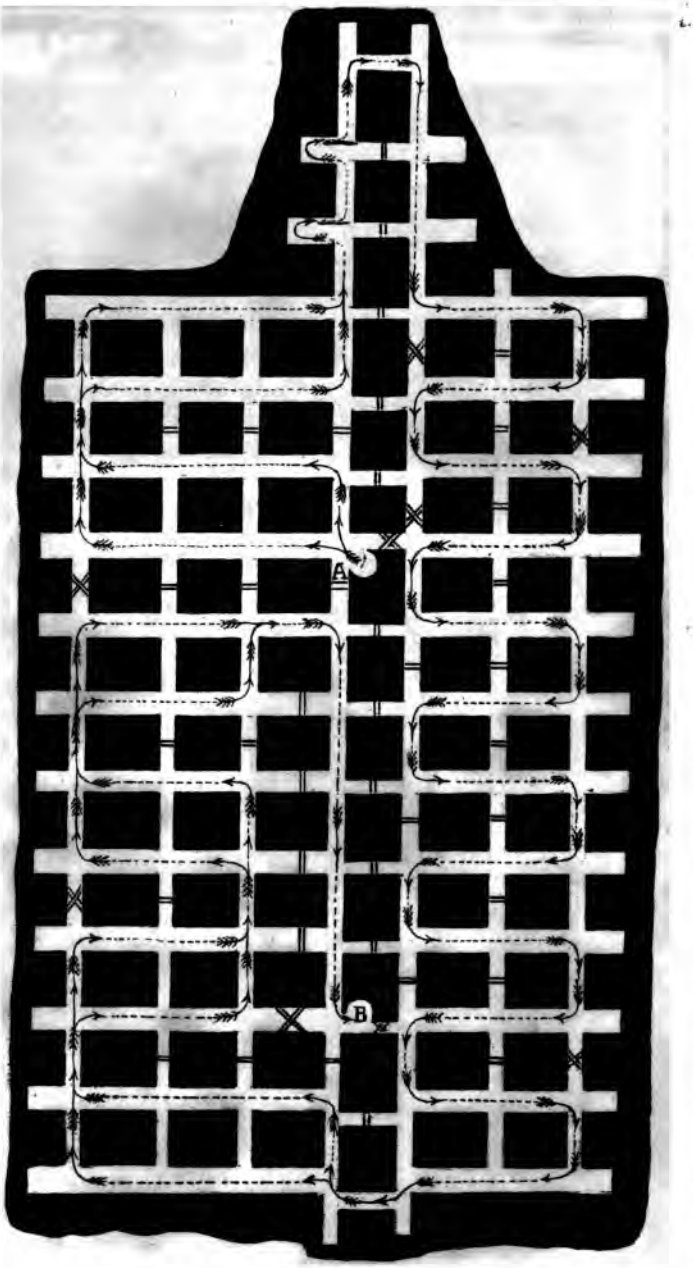
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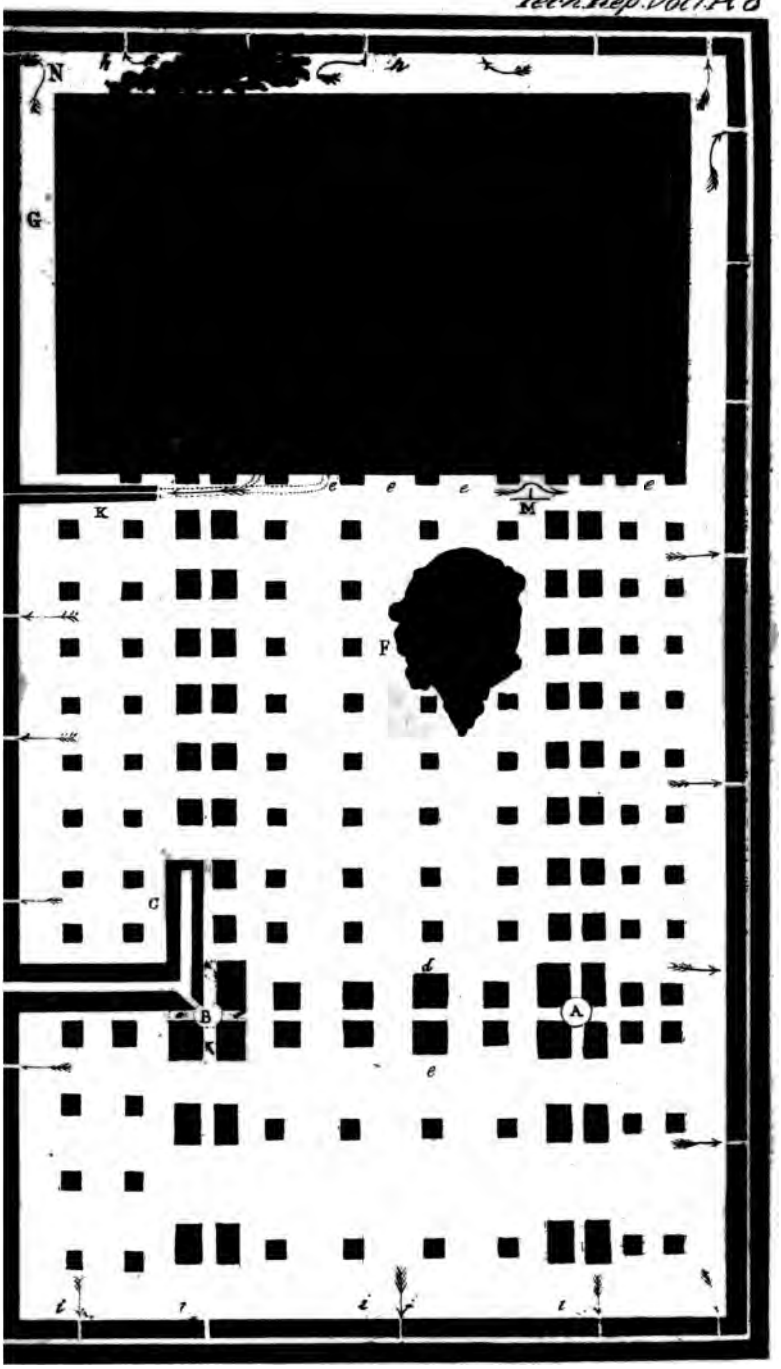
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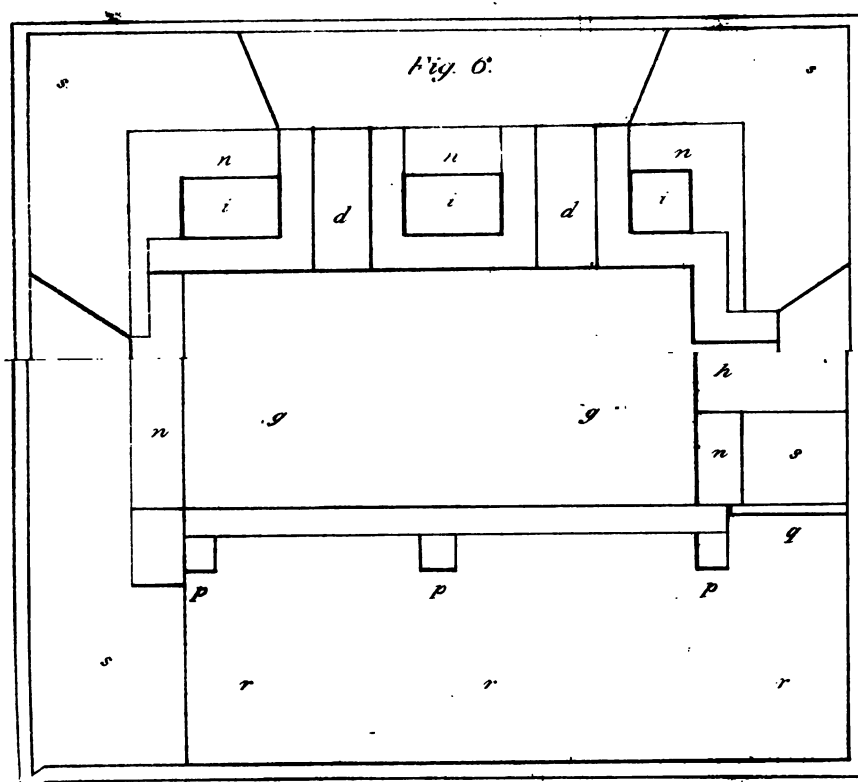

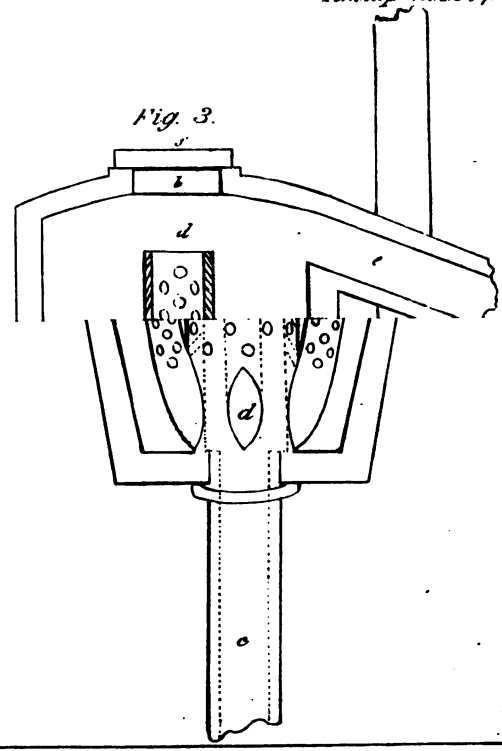

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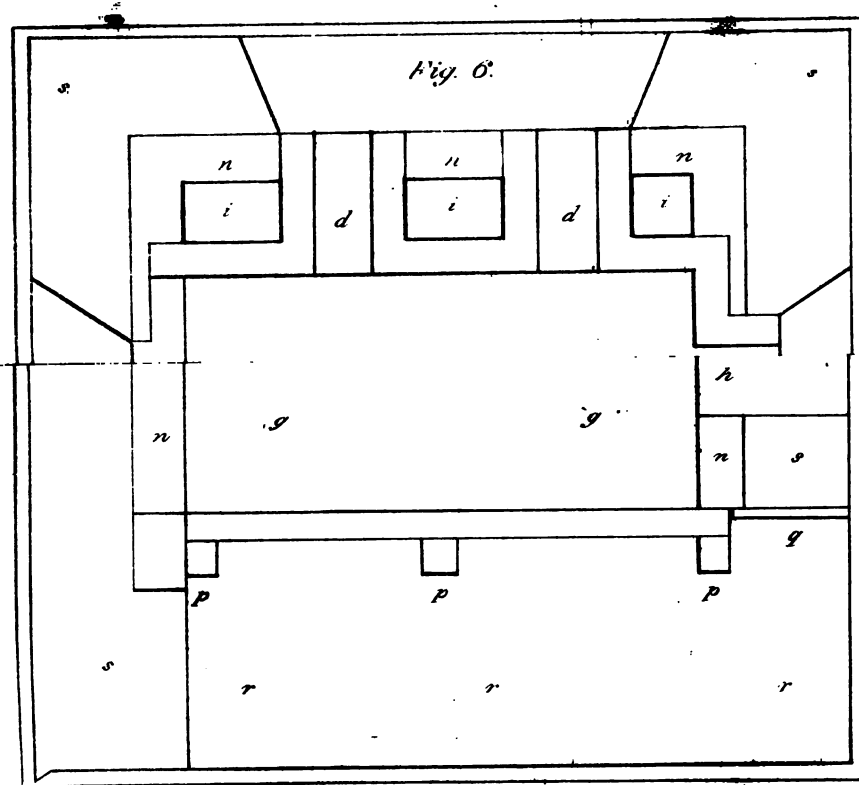

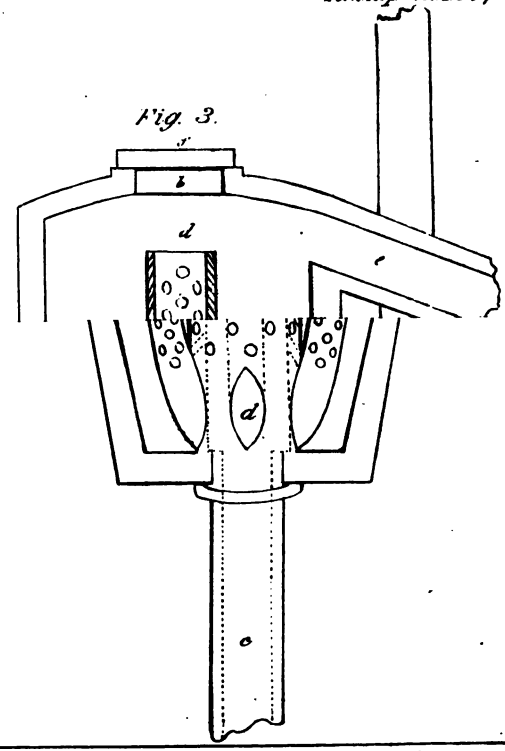

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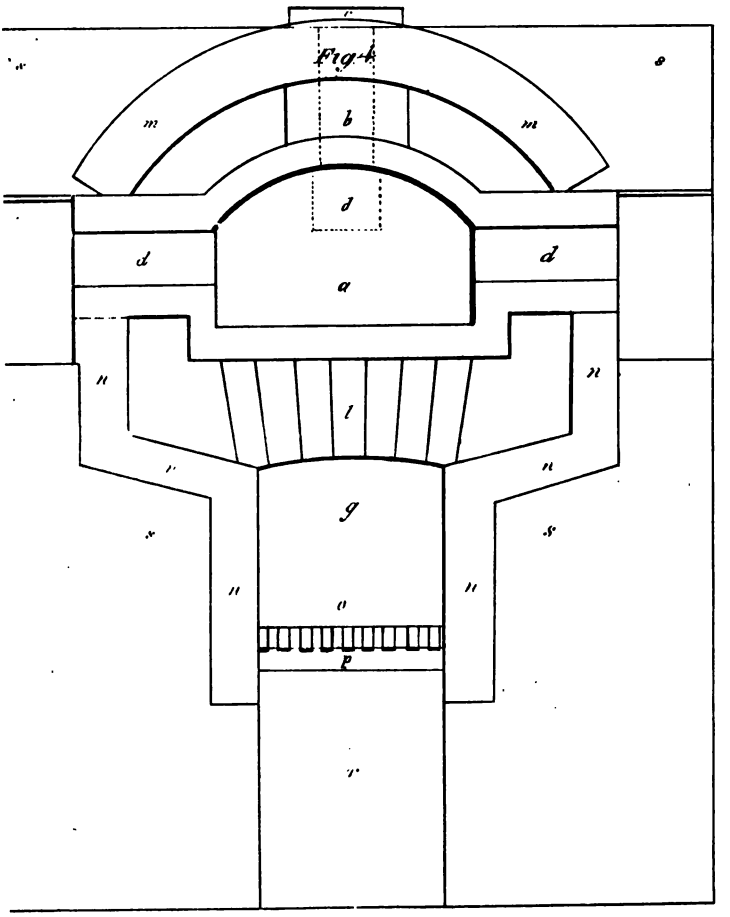

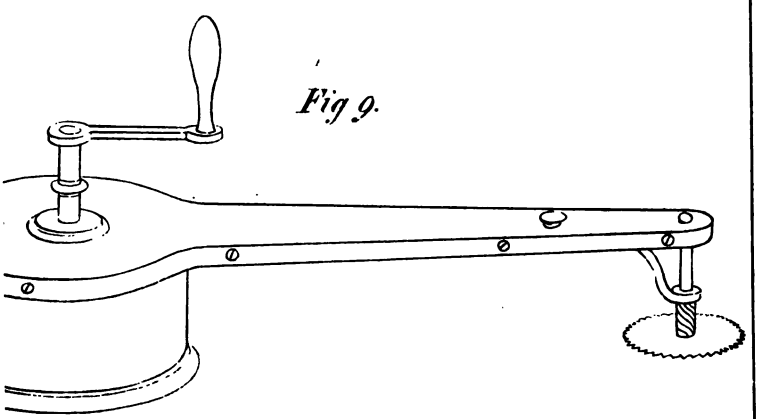

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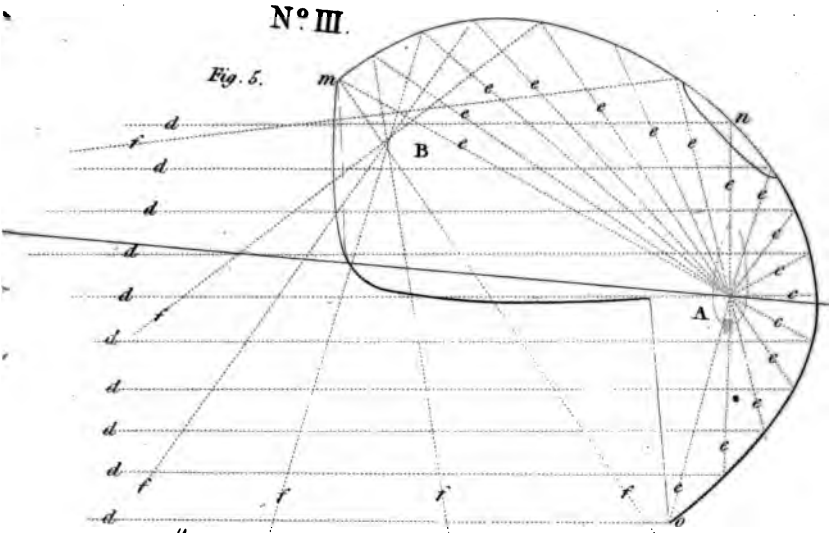

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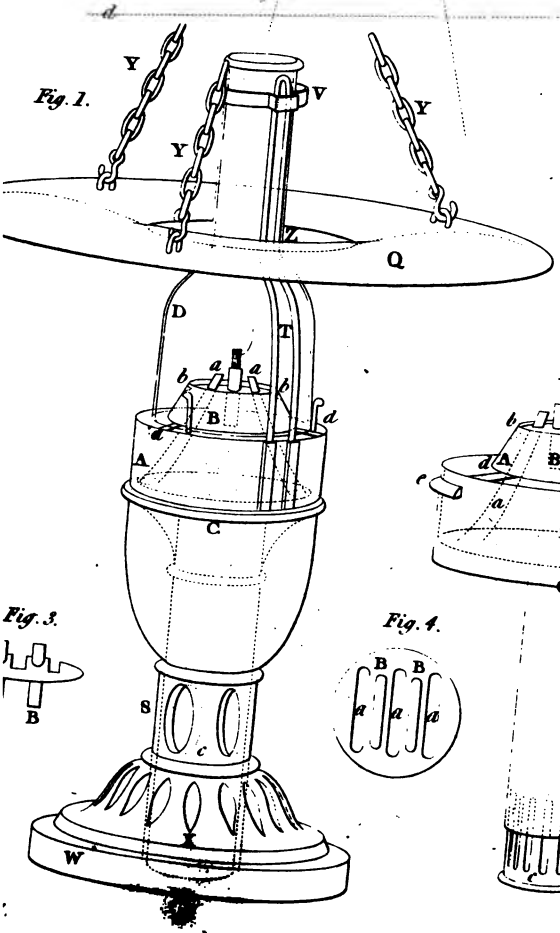

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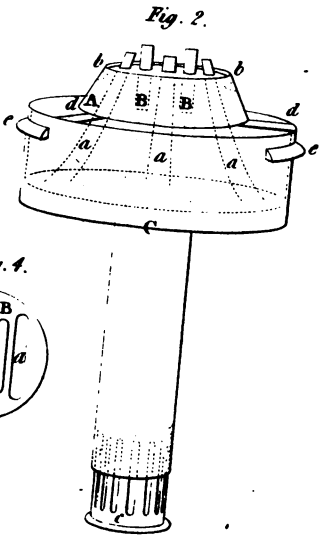

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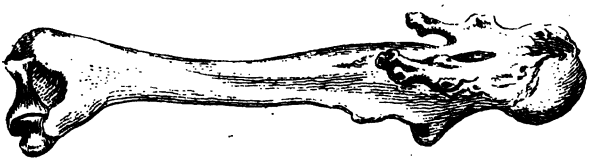

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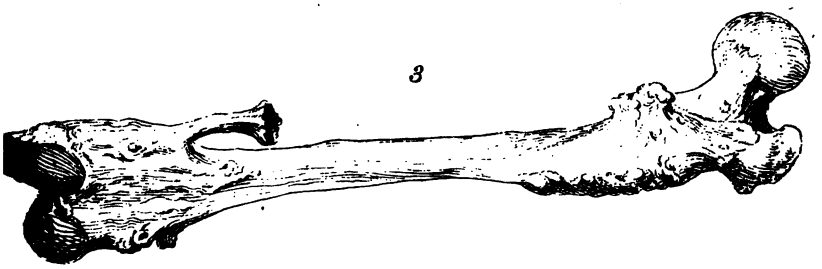

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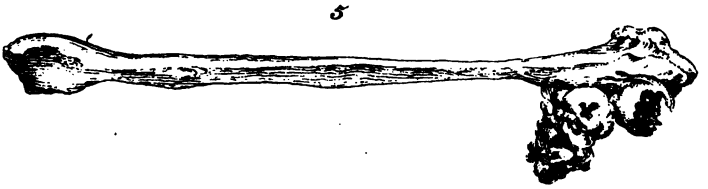

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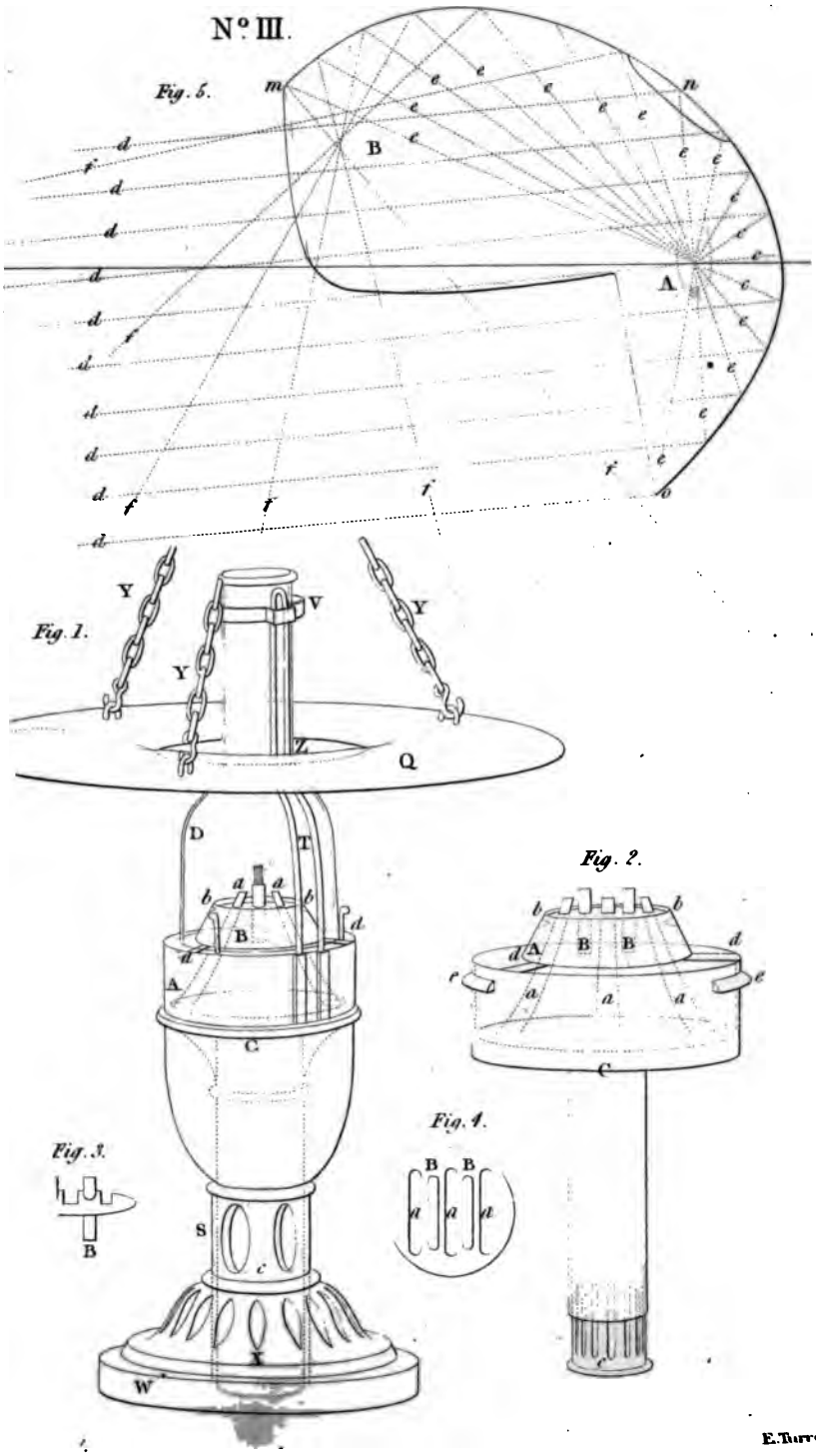

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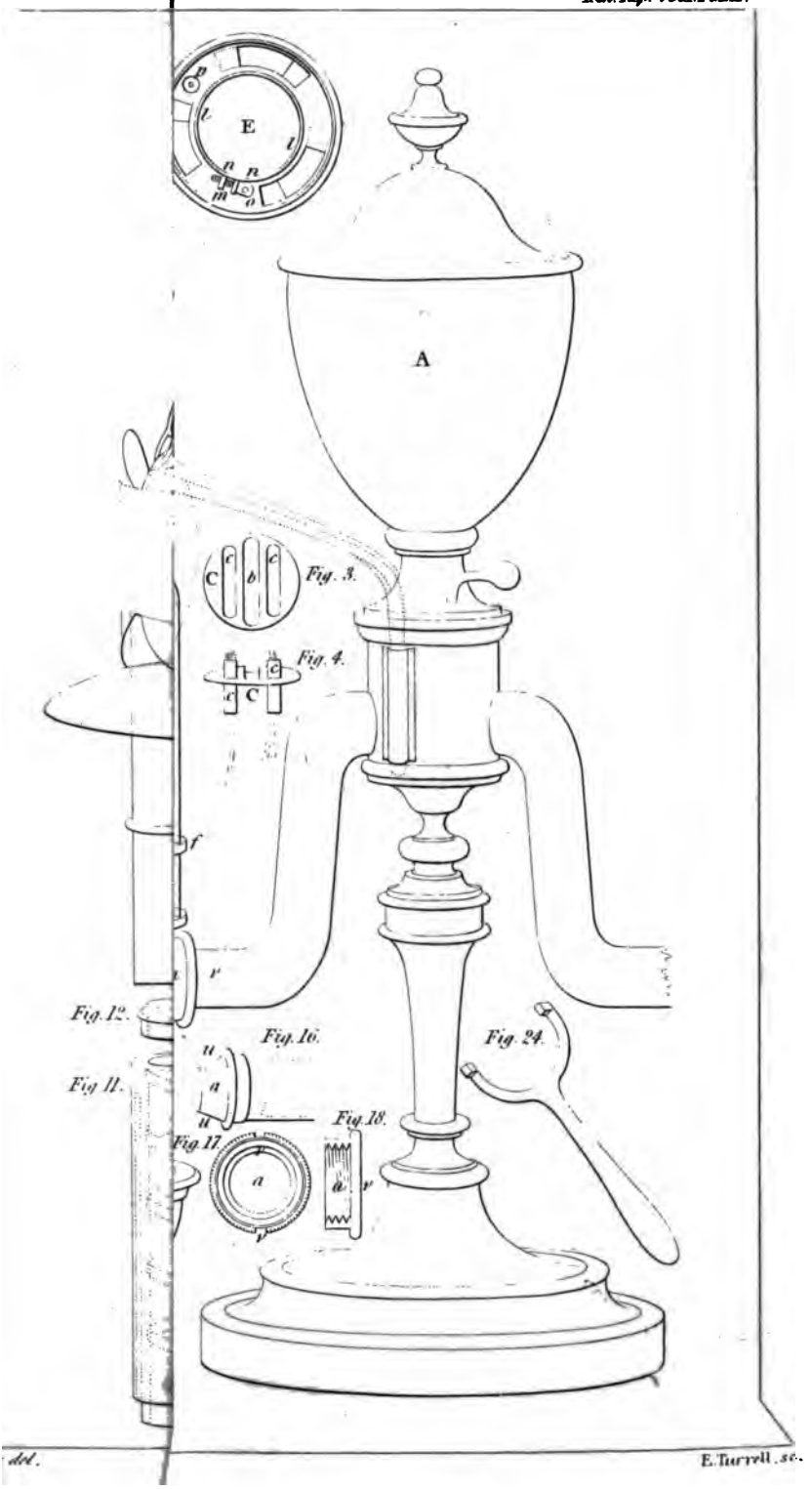
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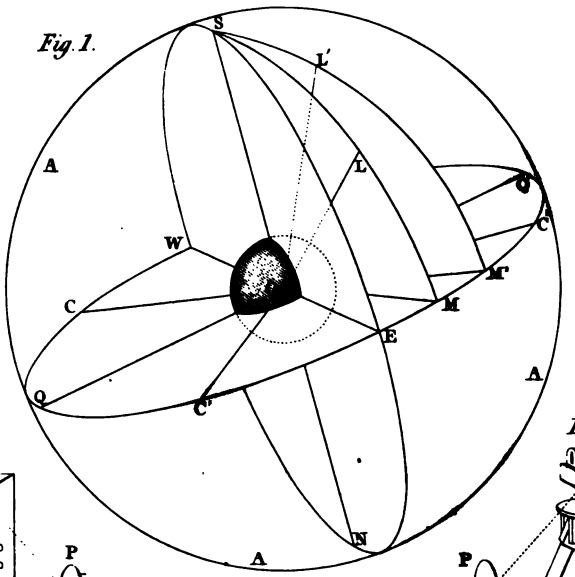

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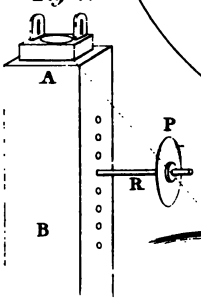

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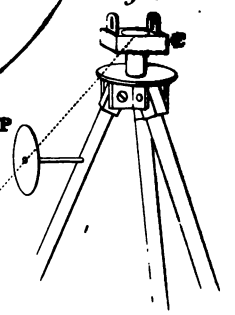

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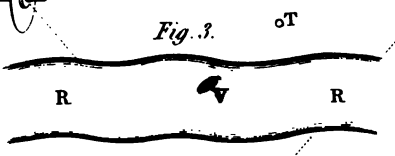

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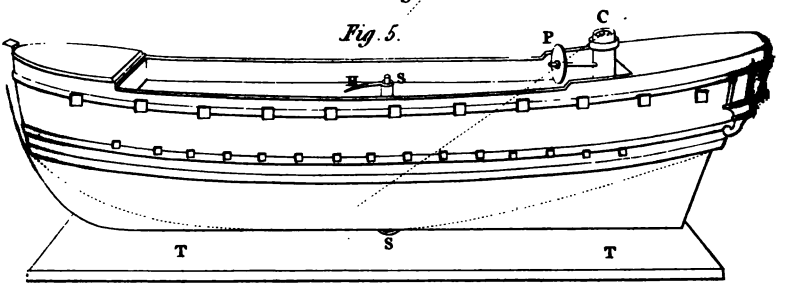

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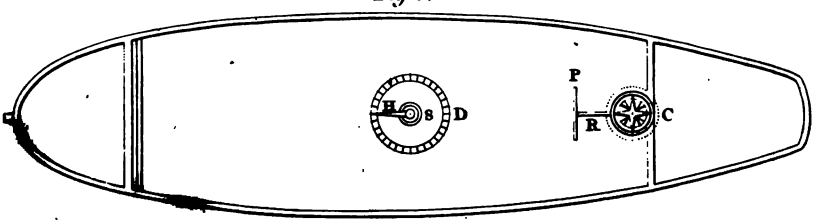

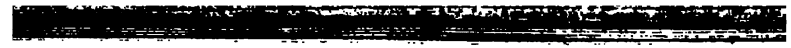

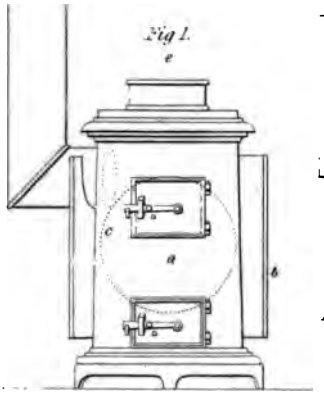
Fig 1.
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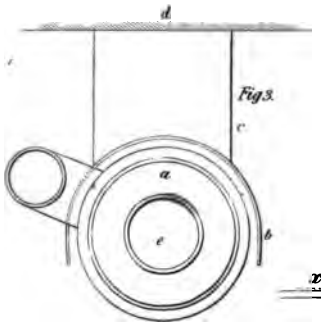
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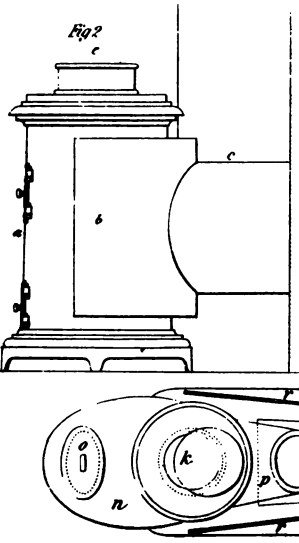
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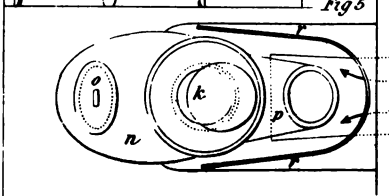
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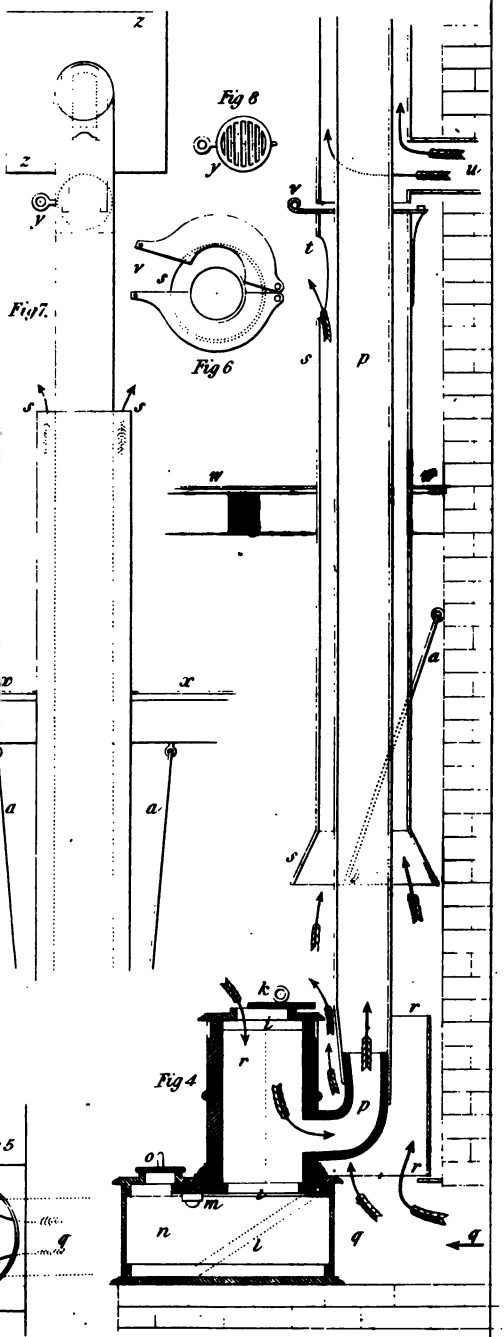
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Fig 7.
Fig 6
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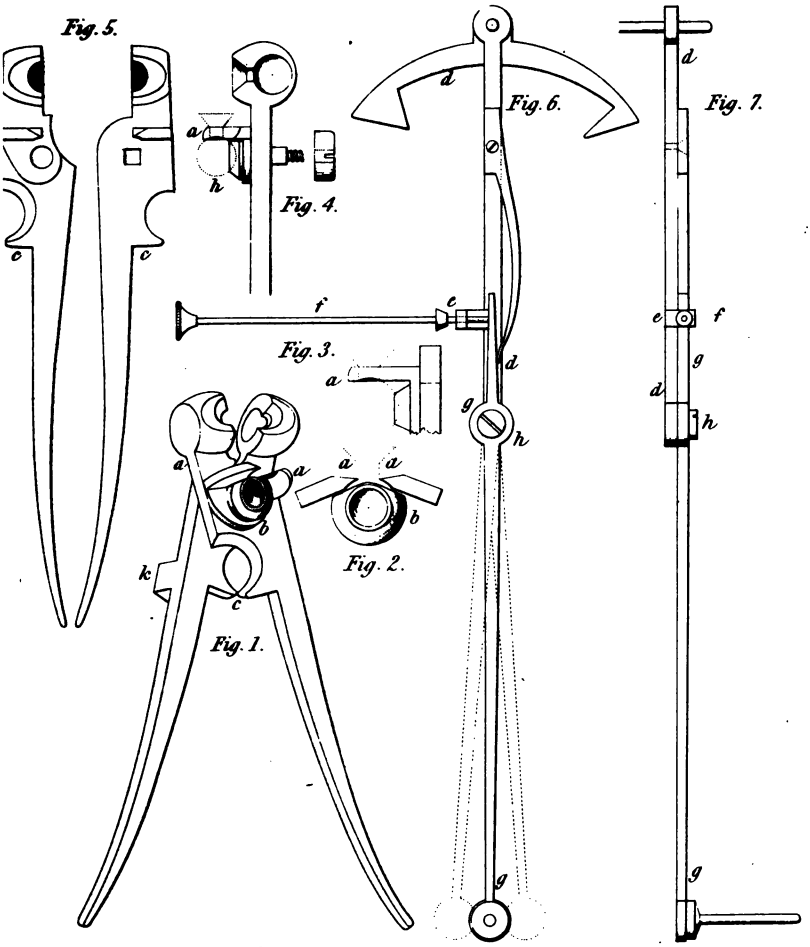
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Fig. 4.
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Fig. 6.
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Fig. 3.
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Fig. 1.
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Fig. 7.
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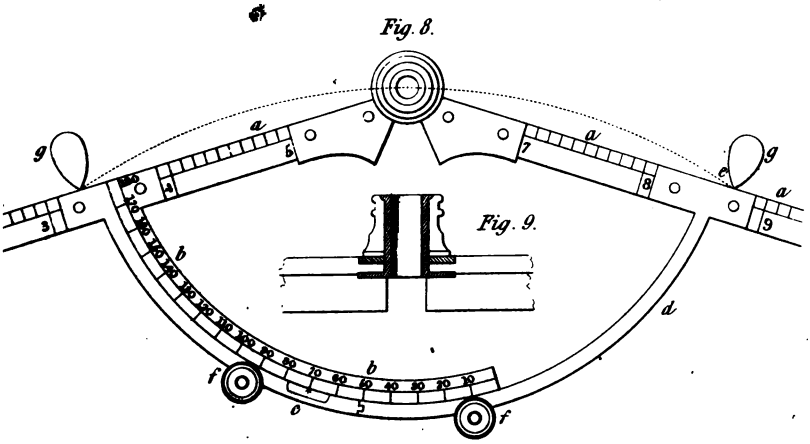
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Fig. 9.
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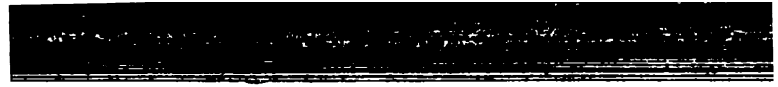

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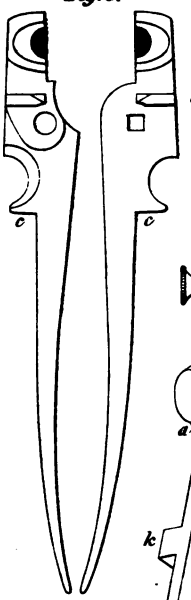

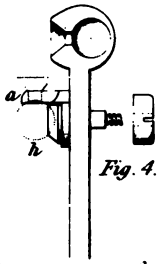

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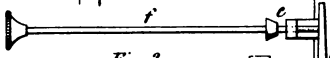

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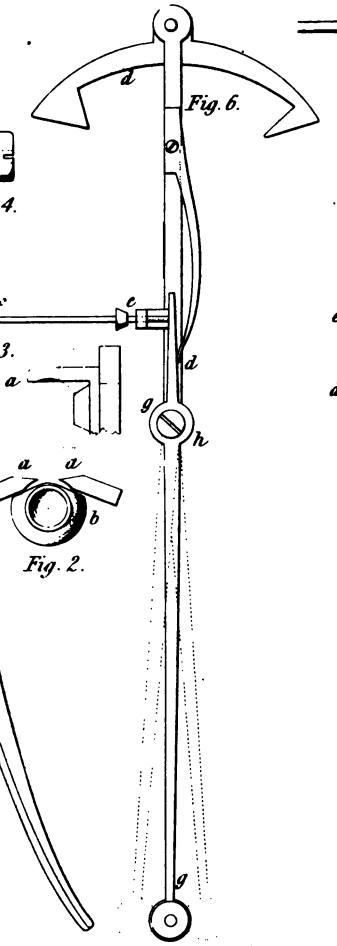

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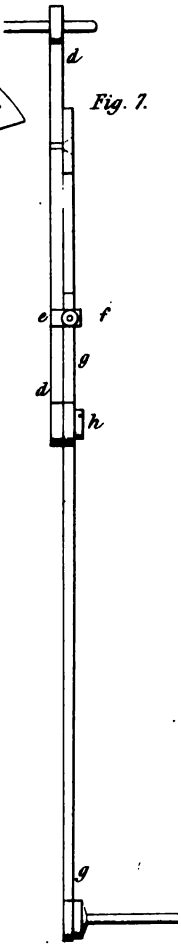

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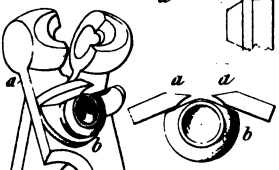

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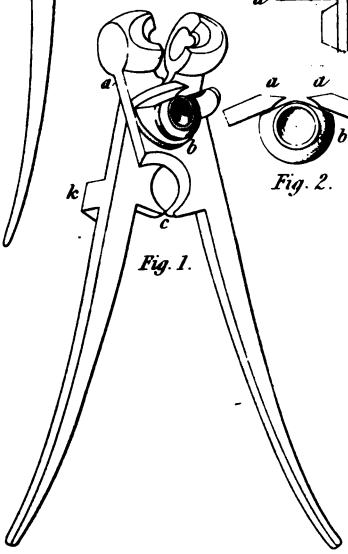

Fig. 1.

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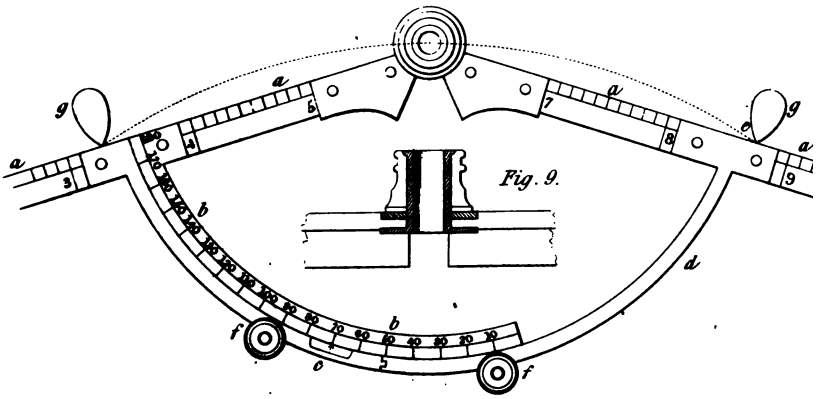

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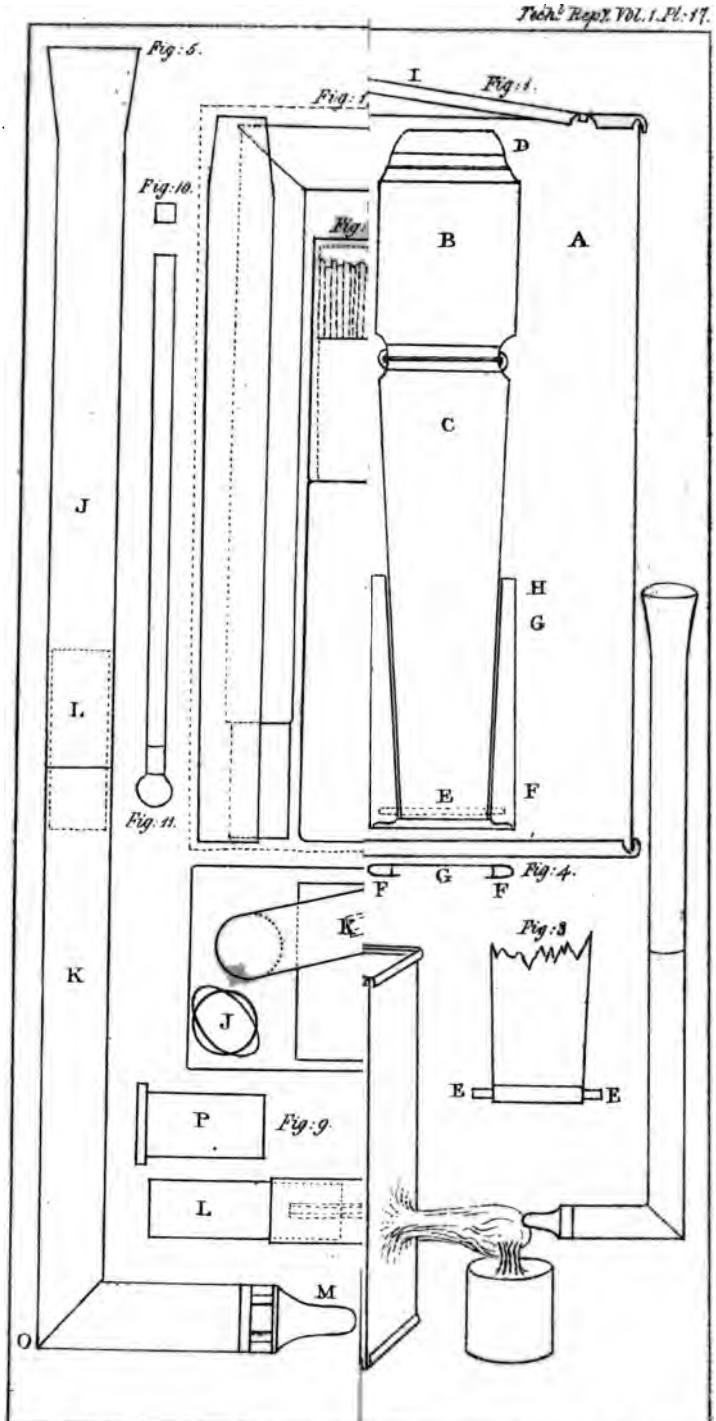
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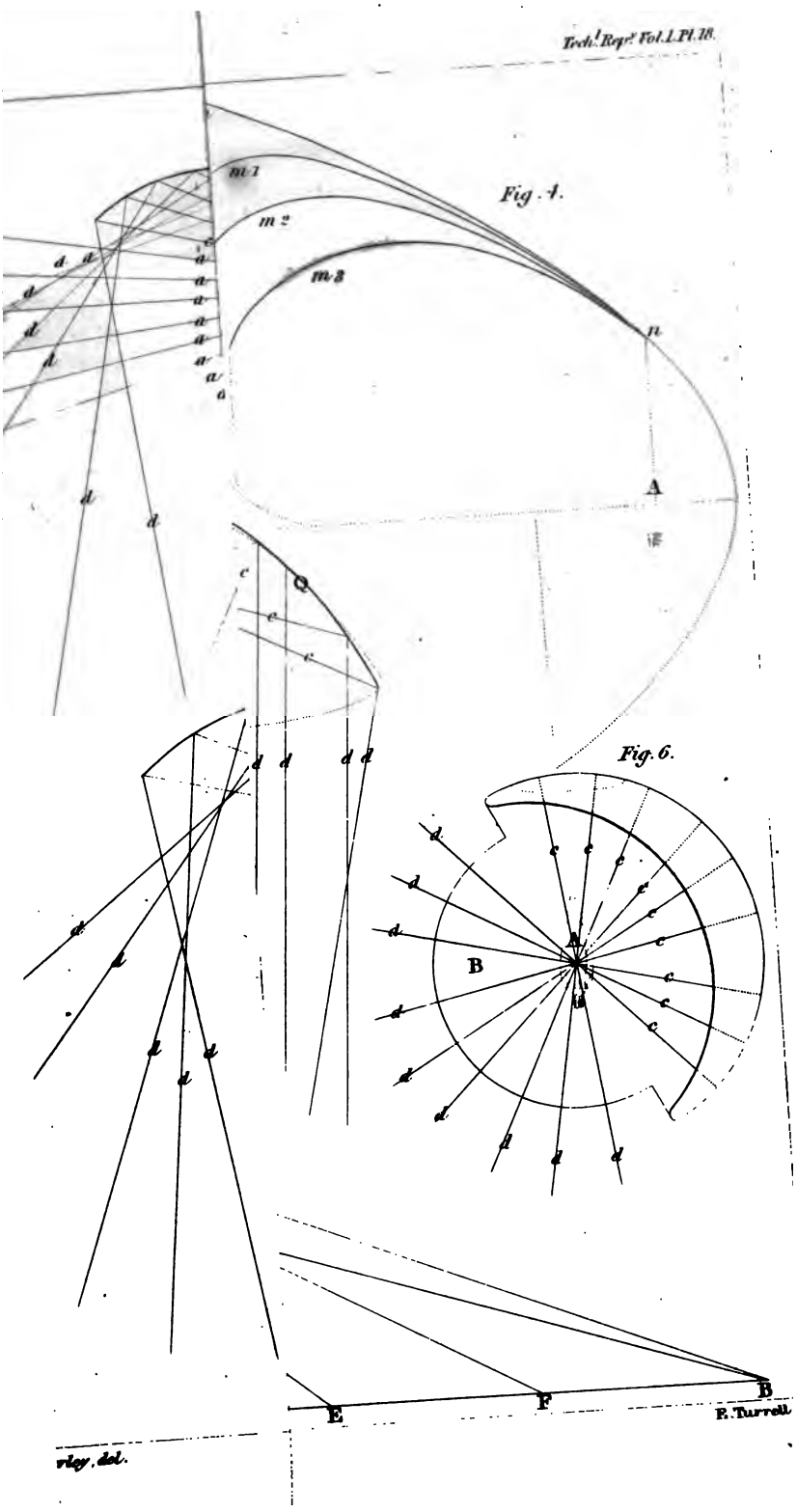
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Fig. 6.
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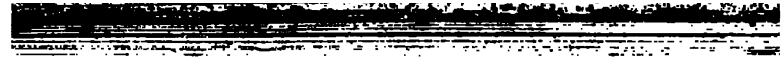

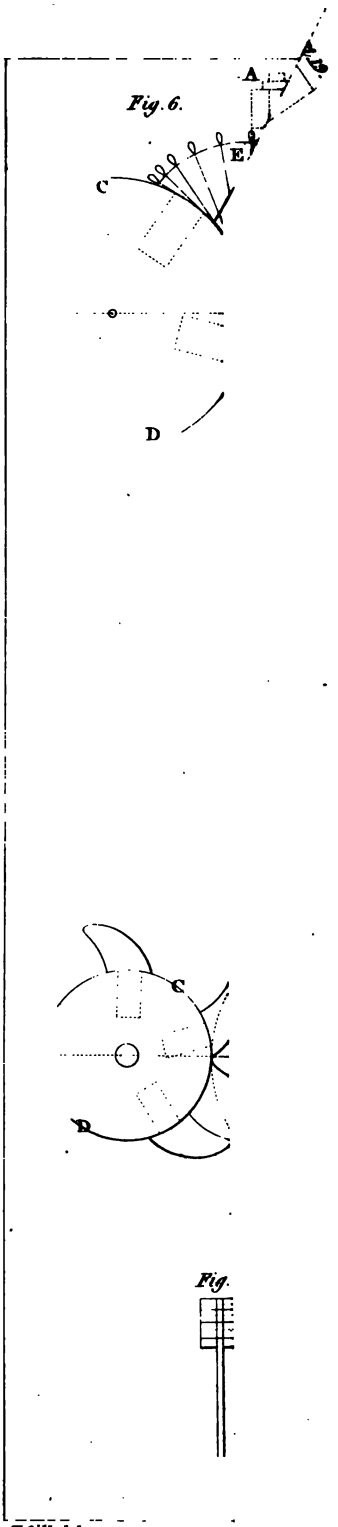

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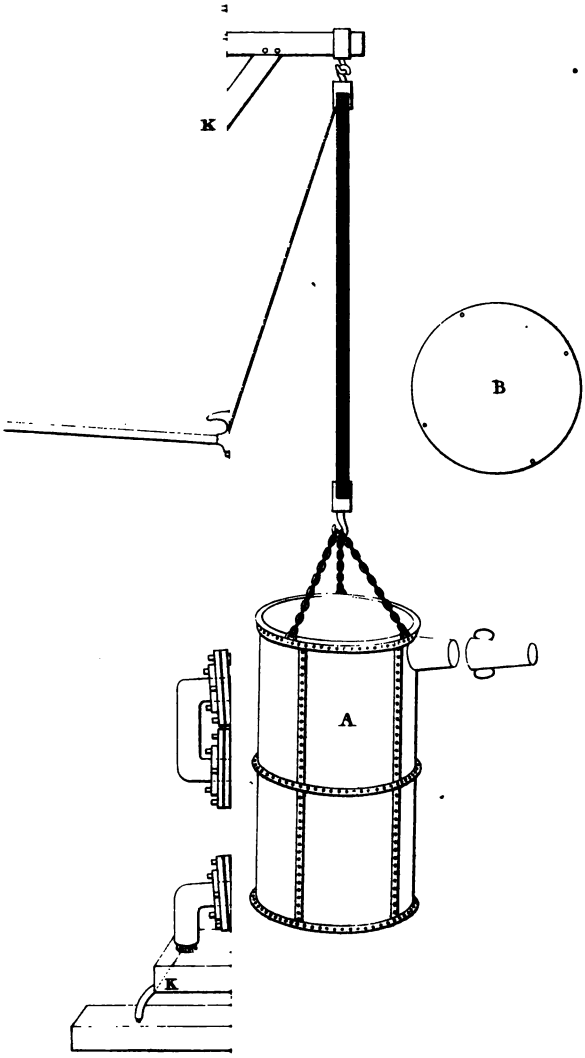
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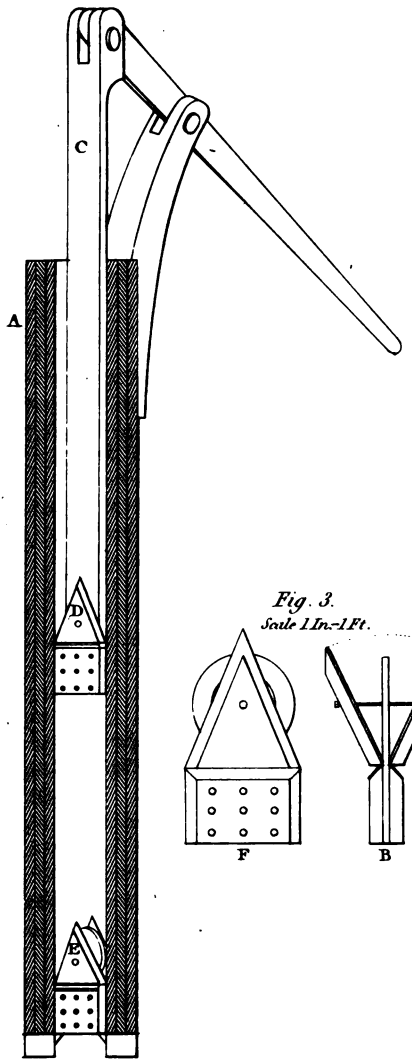

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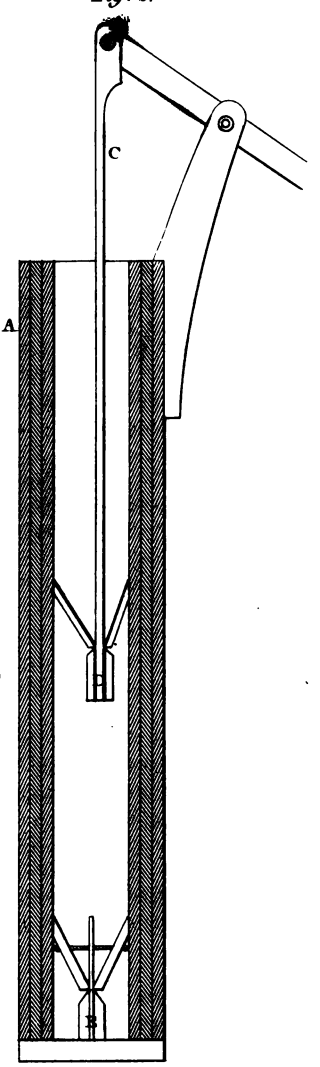

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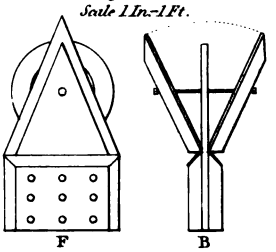

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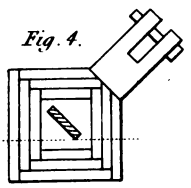

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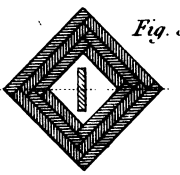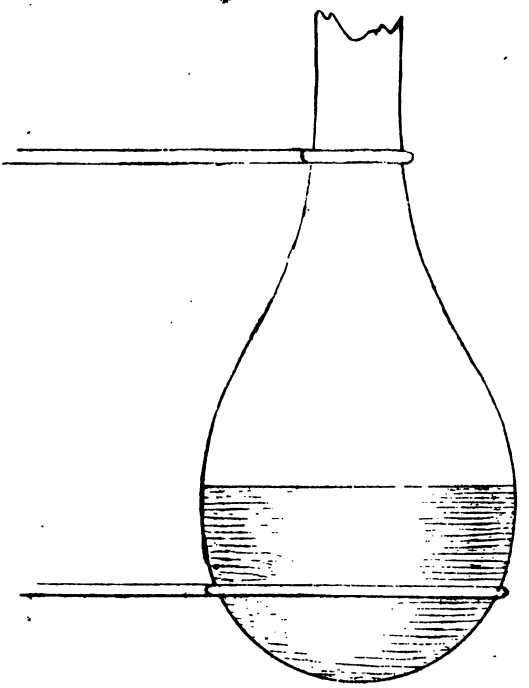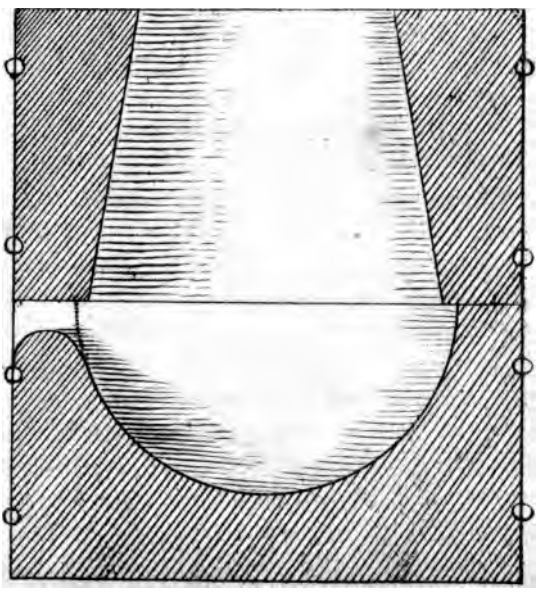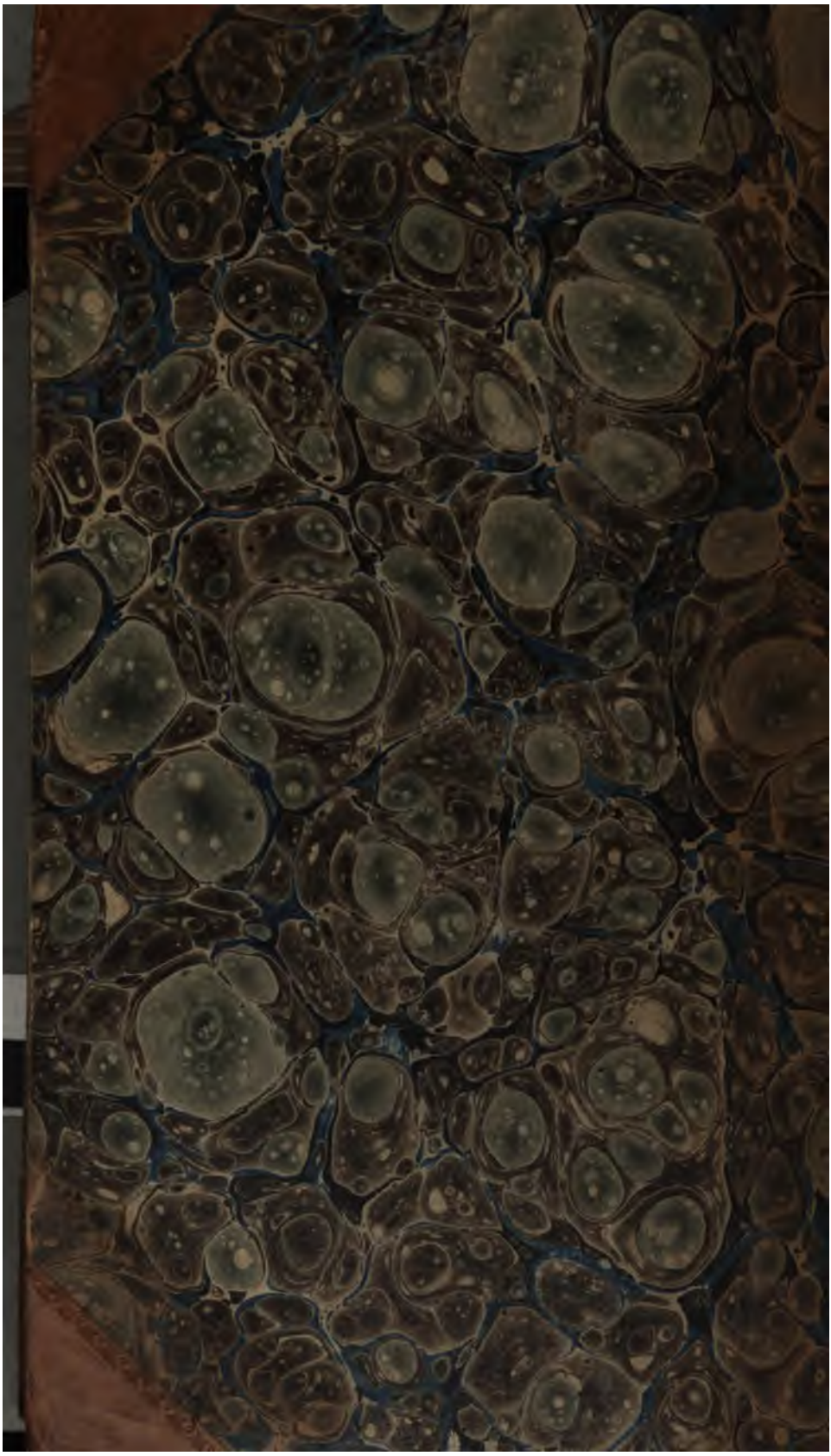
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